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THE ICELANDIC SCALLOP OFF WESTERN GREENLAND

Nuuk, 1987

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The Greenland Institute of Fisheries
and Environment Research

September 1987

THE ICELANDIC SCALLOP OFF WESTERN GREENLAND

Nuuk, 1987

by
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PREFACE

The present report was drawn up by S.A. Pedersen who participated in the Icelandic Scallop Project of Greenland Home Rule.

The Project was initiated in 1984 in cooperation with the Greenland Home Rule Consultant Service as part of an evaluation of the possibilities of commercial exploitation of the Icelandic scallop in Greenland.

The primary aim of the Project is to study how the Icelandic scallop resources off Greenland can be optimally exploited and managed in view of biological criteria such as growth rate, supply of young, etc.

The Icelandic scallop studies conducted up to now have mainly aimed to map the distribution, size, and biology of the scallop stocks. The studies have been carried out to calculate long-term yields of individual populations.

The studies underlying the present report were carried out upon requests from the Directorate of Industries, Greenland Home Rule, and they constitute a follow-up of previously issued research reports :

1) H. Eiriksson (1984). A survey of Chlamys islandica in the Nuuk area in May-June 1984.

2) A. Nicolajsen (1984). A description of the population dynamics of Chlamys islandica in Greenlandic waters, the Nuuk area.

3) H. Eiriksson and N. Nicolajsen (1984). Icelandic scallop fishery at Greenland. Studies in the Nuuk area.

4) S.A. Pedersen (1986). Status of the Icelandic scallop fishery in the Nuuk area. November 1986.

5) S.A. Pedersen and J. Boje (1987). Icelandic scallop at West Greenland. Studies of efficiency of equipment for scallop dredgers.

1. INTRODUCTION

Commercial Icelandic scallop fishery was started at Nuuk in the latter half of 1983, followed by a growing interest in increasing the scallop fishery effort in the area. The scallop fishery was carried out mainly by bigger vessels with manual production of scallop meat (muscle and roe) onboard. In the latter half of 1986, a mechanical production line was installed at GFI (Godthaab Fishing Industry), Nuuk, for processing scallop meat (muscle). This opened up a possibility for smaller vessels without onboard production facilities to sell live scallop to an onshore plant.

On the basis of earlier Icelandic scallop fishery trials in the Nuuk area, the population size was estimated at 13 000 t, and an annual catch quota of about 1300 t was recommended (Eiriksson and Nicolajsen 1984). Reports issued subsequently have discussed these figures (Pedersen 1986, Pedersen and Boje 1987), and there seems to exist a risk that the population becomes/ may become depleted. Therefore, further Icelandic scallop resource studies were carried out in the Nuuk area by the GFM (Greenland Directorate of Fisheries) ship MIŠILIISOQ in the period March 16 - 31, 1987.

Development of the Icelandic scallop fishery at Nuuk gives rise to two questions :

1) To what degree has the Icelandic scallop population been affected by the fishery carried out til today ?

2) Is there reason to change the catch quota of 1300 t per year recommended up to now for the Nuuk area ?

The present report aims to throw light on these two points on the basis of the March 1987 study and the new catch information based on the commercial fishery.

2. BIOLOGY OF THE ICELANDIC SCALLOP

2.1 Distribution

The scallop inhabiting the Greenlandic waters is Chlamys islandica. It is the northernmost scallop, occurring along the coasts of North Norway, Iceland, East Greenland, Canada, and Alaska in waters with temperatures ranging from below 0 to about 10°C.

In the coastal waters, the scallop mainly occurs at depths of 15 to 60 m. In Jan Mayen and Bjornoe, the largest occurrences are found at depths of 70 - 100 m and in Svalbard at 35 - 70 m.

Scallops are found mainly on hard bottoms but also on sandy, gravelly, stony, and sometimes clayey bottoms. The scallops are fastened to the bottom, which means that they can live in places with quite strong currents.

2.2 Anatomy

The body (soft parts) of the Icelandic scallop can be observed by removing the left valve; see Figs. 2.1 and 2.2.

The scallop's body is covered by a thin, almost transparent mantle which thickens towards the edge of the shell. The thickened part is attached to the edge of the two valves.

The thickened edge of the mantle is dark-colored, and it has three lobes. A number of eyes can be seen along the middle lobe, between tentacles of various sizes (Fig. 2.1).

The tentacles are used for feeling and smelling. The function of the eyes is not fully known, but it is known that they can distinguish between light and dark; the scallop shell closes if light conditions change suddenly.

The mantle has several important functions. It secretes the shell, participates in the scallop's oxygen uptake, and controls water circulation in the scallop.

A white, round adductor muscle responsible for shell opening and closure can be seen in the middle of the scallop. The adductor muscle is the commercially interesting part of the scallop.

The adductor muscle consists of two muscles, a big one and a small one. The big one can close the shell very fast, while the small one functions more slowly but is stronger and capable of more sustained effort. This muscle is used to hold the shell closed for longer periods.

On each side of the body there are paired gills with important functions. Together with the mantle, they function as the scallop's respiratory organ, and they are also used in feeding.

Behind the gills are the sexual organs (gonads, i.e., roe and milt), which constitute a large sac along the edge of the adductor muscle. In females, the gonads are red to orange, while in males they are milky white to grey.

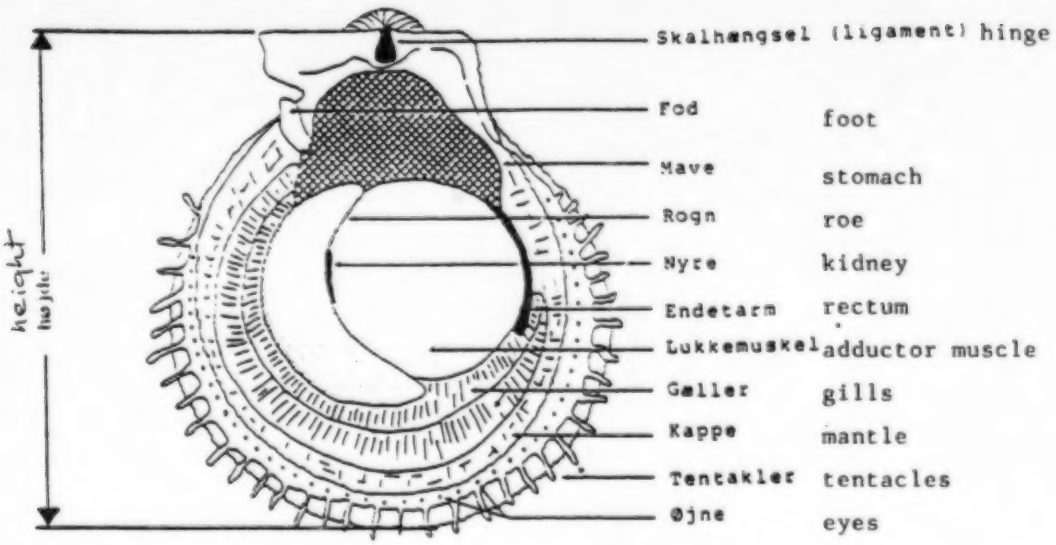
2.3 Feeding and growth

The scallop filters its food from the seawater flowing through its gills. The gills have dense fine cilia capable of moving with several vibrations a second, to pump water through the gills and the scallop. Scallops depend on food transported by currents, and therefore they are most numerous in areas with strong currents.

It is not known excatly what the scallops eat, but most probably most of their food consists of the microscopic phytoplankton. The growth of the scallop depends essentially on the amount of available food, but also water temperature plays a role in its growth rate.

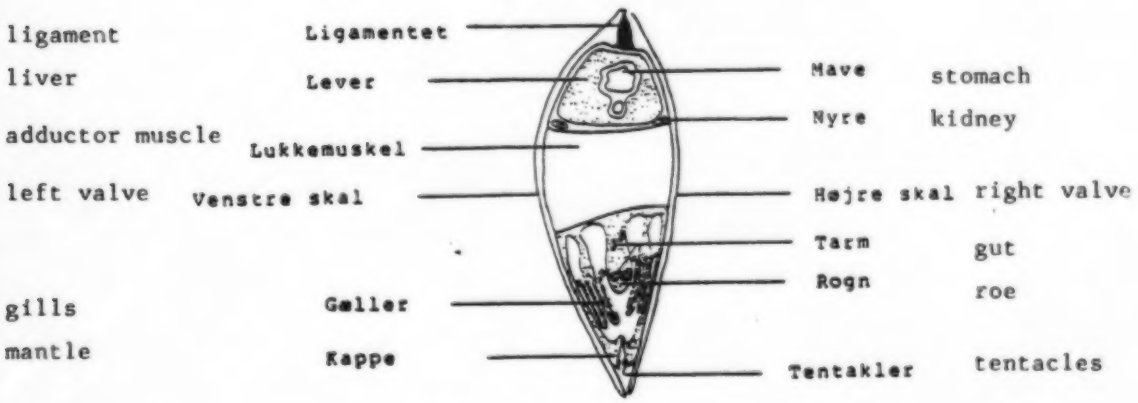
The growth of the scallop is usually measured by the annual shell height increment (Fig. 2.3).

There are great seasonal variations in food supplies in the northern waters. Phytoplankton is abundant in the summer but declines in the latter half of the year to disappear completely in the winter. This means that growth varies with seasons, creating a characteristic pattern of growth zones on



Figur 2.1 Bløddele af kammusling. Venstre skal fjernet.

Fig. 2.1 Soft parts of the Icelandic scallop. Left valve removed.



Figur 2.2 Snit tværs gennem en kammusling, der viser muslingens indre anatomi.

Fig. 2.2 Cross section of Icelandic scallop, showing internal organs.

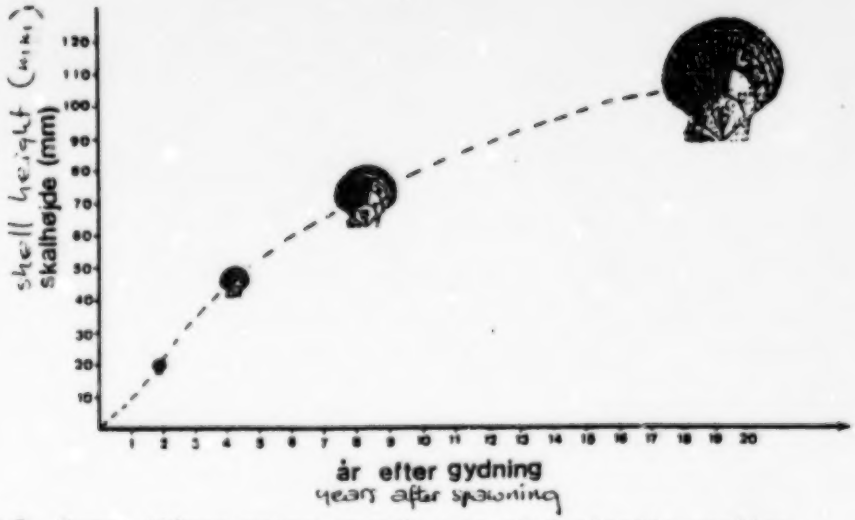


Fig. 2.3 Curve illustrating growth rate of Icelandic scallop throughout a period of up to 20 years

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the shell and the ligament. The zones are used for age determination and growth assessment.

2.4 Reproduction

The scallops along the coast of North Norway reach sexual maturity at a shell height of 35 - 45 mm, when they are 3 - 5 years old. Spawning takes place in June-July. It is not known what induces spawning, but temperature changes may be one reason. Males and females discharge eggs and milt in the water, where fertilization occurs. For the spawning to be successful, there must be large numbers of eggs. Countings carried out in Balsfjord, North Norway, show that about 75 million eggs/m^2 can be spawned on one scallop bed.

The eggs and larvae are planktonic for the first 3 - 8 weeks, whereafter the larvae settle on the bottom. The bottom has to constitute a suitable "anchorage" for the larvae. The best anchorage places seem to consist of locations where scallops are already living or where there are dead scallops.

Studies of scallop populations indicate that recruitment to populations (year class size) may fluctuate very much. Several years may pass without recruitment, followed by a year with abundant recruitment.

Several reasons may contribute to a poor (numerically small/failed) year-class of scallops :

1) Spawning may be poor due to temperature conditions

2) A great part of the larvae may be eaten by predators

3) Feeding conditions may be unfavorable for the larvae and the small young

4) Marine currents may transport the larvae to areas with bottoms unsuitable for anchorage and survival of the young.

3. STUDIES WITH R/V MISILIISOQ - SPRING 1987

3.1 Methods of study

The Directorate of Industries conducted a fishery trial in May-June 1984 with the fishing boats NYBORG, POLARFISK, and SAARULIK, to study the basis for commercial scallop fishery at Nuuk. The catches from these trials constituted the material for the report "Icelandic Scallop Fishery at Greenland. A study in the Nuuk area." by H. Eiriksson and A. Nicolajsen (1984). The report estimated the distribution and population sizes of the Icelandic scallop.

During the March 1987 study with MISILIISOQ, the localities dredged were the same as those in 1984. Therefore, it was possible to assess possible changes in quantitative distribution and densities in individual localities between 1984 and 1987. Dredging was also conducted in some localities where scallop distribution and density had not been studied yet.

Equipment and procedures

The dredge (borrowed from KIS) had the following dimensions :

Width	960 mm
Height	360 mm
Mesh size	120 mm

The underside of the bag was reinforced with a piece of nylon carpet to keep the bag from being torn by the rough bottom (see Fig. 3.1).

Fig. 3.1 The KIS dredge used in the trial.

The dredge, which was relatively small, was found well-suited for dredging from MISILIISOQ. Different drag durations were tried, and it was judged that a five-minute drag at an approximate speed of 2 knots was sufficient to register whether scallops were present. Correspondingly, this drag duration was long enough to fill the dredge in the best locations.

The scallop catches from the different dredging grounds were subjected to shell-height measurements and weighing. Shell heights were measured with sliding gauges, rounding the values down to the nearest mm. Samples collected for laboratory analyses were labelled and frozen immediately.

In the laboratory, the shell heights of the scallops were measured, and their total weights, shell weights, soft parts, muscles, and sexual organs were registered. Sex was determined by gonad color (white and grey gonads (milt) = males; reddish to orange gonads (roe) = females). Age was determined by the growth zones of the ligament (Johannesen 1973).

Participants in the study conducted with MISILIISOQ, March 1987 :

Soren Anker Pedersen (biologist), Hasselbach Sorensen (fisheries advisor), Aage Pedersen (captain), Manarseeraq Egede (sailor), Jorgen Lundblad (sailor).

Laboratory analyses of the scallop samples were carried out by :

Soren Anker Pedersen (biologist), Susan Arum (lab. technician).

3.2 Assessment of population size and distribution

All dredgings carried out by MISILIISOQ in the period 16 - 31 March 1987 are marked on charts in the Appendix (Fig. 3.2, a and b).

The Nuuk area was divided in several study areas, depending on bottom and production conditions for scallops (see Appendix, Fig. 3.3) (Nicolajsen 1984).

Table 3.1 (App.) shows all drags, with information about the banks, areas, catches in kg of live scallops, and relative quantities of shells from dead scallops. The average catch per drag is calculated for each study area.

Table 3.2 shows total quantities caught, fishing times, and quantities caught per 5 minutes for the 11 study areas.

Table 3.2 Fishing times, catches, and catches per time unit, distributed over the 11 study areas at Nuuk. Dredge width 96 cm, dredging speed 2 knots.

Area		Fishing time(min)	Catch (kg)	Catch per 5 min (kg)
Qeqertarssuaq	(1)	50	388.5	38.9
Kigtorqat-Qilangaarssuit	(2,3)	45	213.8	23.8
Angissorssuaq-Akilia	(4)	35	380	54.3
Aligortoq-Narssaq	(6)	30	270.4	45.1
Qaqssissaqdlit	(5,7,8)	125	841	33.6
SE of Angissuunguaq	(8)	30	145.2	24.2
Simiuta-Angissuunguaq	(10,11)	30	161	26.8
Amitsoq	(12)	5	8	8
Ugpik	(13)	15	170	56.7
Kobbefj-Rypøsen	(13,14,15)	25	253	50.6
Qegertat	(16)	50	445	44.5
All areas		440	3275.9	37.2

The Table shows that MISILIISOQ caught a total of 3276 kg of scallops. On an average, 37 kg were caught per each 5-minute drag. The best catches were taken in the areas Angissorssuaq-Akilia, Ugpik, and Kobbefjord-Rypeoen.

The average catches in kg per m^2 dredged were calculated for each of the 11 study areas, on the basis of a dredging speed of 2 knots and the dredge width used. The results are shown in Table 3.3 together with the corresponding values from the 1984 study.

Table 3.3 Calculated average catches in kg per m^2 and area in 1984 (acc. to H. Eiriksson and A. Nicolajsen 1984) and in 1987 (present study with MISILIISOQ)

Area		Average catch in kg per square meter	
		May–June 1984	March–April 1987
Qeqertarssuaq	(1)	0,206	0,131
Kigtorqat-Qilangaarssuit	(2,3)	0,212	0,103
Angissorssuaq-Akilia	(4)	0,192	0,183
Aligortoq-Narssaq	(6)	0,289	0,152
Qaqsaissaqdlit	(5,7,8)	0,155	0,092
SE of Angissuunguaq	(8)	0,195	0,077
Simiuta-Angisuunguaq	(10,11)	0,158	0,091
Amitsoq	(12)	0,122	0,027
Ugpik	(13)	0,171	0,191
Kobbefj-Rypeoen	(13,14,15)	0,203	0,164
Qegertat	(16)	0,118	0,150
All areas		0,197	0,124

On the whole, the average catch was poorer in 1987 than in 1984. The 1987 catches were better only at Qegertat and Ugpik. For all areas dredged, the average catch was 0.20 kg per m^2 in 1984 and 0.12 kg per m^2 in 1987.

Calculation of population sizes (Table 3.4)is based on the same dredge efficiency and distribution area of scallops as it was based in 1984, namely 15.5 % and 10.2 km^2, respectively. The total scallop population

for the entire Nuuk area was estimated at 8651 t in 1987 (Table 3.4), as against 13 000 t in 1984. This is a drop of 34 %.

Population sizes were calculated for each of the 11 areas, and they were compared with those of 1984. The differences between the 1984 and the 1987 results are given in Table 3.4. The biggest differences in the calculated population sizes were found for Amitsoq and SE of Angisuunguaq, where the 1987 populations were calculated to be 79 % and 60 % smaller than in 1984, respectively.

Table 3.4 Calculated populations in t per area in 1984 (acc. to H. Eiriksson and A. Nicolajsen 1984) and in 1987.

Area		Calculated population size, t		
		1984	1987	Difference
Qeqertarssuaq	(1)	2729	1735	-994
Kigtorqat-Qilangaarssuit	(2,3)	1368	665	-703
Angissorssuáq-Akilia	(4)	1697	1619	-78
Aligortoq-Narssaq	(6)	1916	1006	-910
Qaqssissaqdlit	(5,7,8)	1542	916	-626
SE f Angissuunguaq	(8)	419	168	-251
Simiuta-Angisuunguaq	(10,11)	510	290	-220
Amitsoq	(12)	271	58	-213
Ugpik	(13)	187	213	+26
Kobbefj-Rypeøen	(13,14,15)	2239	1813	-426
Qegertat	(16)	129	168	+39
All areas		13007	8651	-4356

3.3 Size distribution

To estimate the size distribution of scallops, the shell height of all live mussels dredged at selected stations were measured.

Table 3.5 (Appendix) shows the number of scallops bigger than, and smaller than, 65 mm. (65 mm is the minimum size for commercial scallops.)

The average size distributions were compared (Fig. 3.4), to evaluate whether any changes have taken place between 1984 and 1987. A great majority of the scallops measured about 87 mm both years; there are no indications of changes in the size distribution. Somewhat more numerous small scallops (below 65 mm) were caught in 1987 than in 1984; most probably this can be attributed to more careful sorting in 1987.

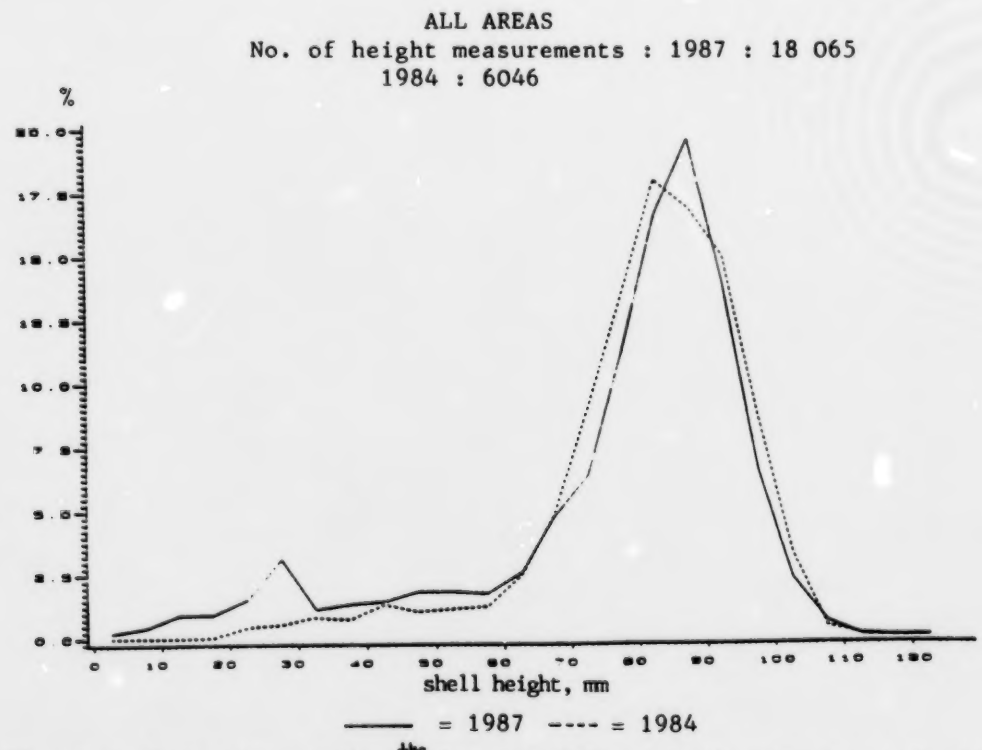

Fig. 3.4 Comparison between the 1987 and 1984 size distributions of all scallops subject to shell measurement.

Fig. 3.5 a – p (Appendix) compares average size distributions between the different dredging areas. A noticeable difference between the 1984 and the 1987 size distributions can be seen only in Area 6 (Narssaq) – Fig. 3.5 (e)

and Area 13 (Ugpik) - Fig. 3.5 (1). However, it has to be pointed out that in Area 6, the number of measured scallops was only 137 in 1984 as against 1375 in 1987. Similarly, the number of measured scallops in Area 13 was only 130 in 1984, while it was 1204 in 1987. Therefore, it is probable that the difference observed between the size distributions in 1984 and 1987 can be attributed to that the small samples of 1984 were not representative of the areas in question.

The average size of scallops caught at Narssaq, Ugpik, and Kobbefjord (Appendix, Fig. 3.5 - e, l and m) was smaller than in the other areas. It ranged from 60 to 95 mm, with a peak at 75 mm. For most other areas, the size ranged from 70 to 105 mm, with a strong peak at about 90 mm.

The small number of small scallops in the catches (below 65 mm) indicates that recruitment of young scallops to the population is poor. If the recuitment were good, it would show as strong peaks over the curves in Fig. 3.4. There are no indications of this in any of the areas (App., Fig . 3.5 a to p).

The shortage of small scallops could mean that the meshes of the dredge bag did not hold the smallest scallops. However, this explanation is not probable, because the meshes get blocked very fast, which would hold the smaller scallops. Besides, spawn and small scallops are fastened either to large live scallops or to the empty shells of dead scallops; and therefore, they are caught together with the big scallops. Another explanation could be that spawn and small scallops are found in shallower water or in certain areas where they are not exposed to fishery. However, this is not probable either, because the best growth conditions for young scallops seem to be the localities where the mature scallops stay.

3.4 Growth

The growth of the scallops in the Nuuk area was evaluated on the basis of average shell height in each year class. The growth curves were obtained by applying von Bertalanffy's growth function to the average shell heights in each year class (von Bertalanffy 1938) :

$$H_t = H_{max} \, (1-e^{-K(t-to)})$$

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where

H_{max} = the biggest theoretical shell height

K = rate at which shell height approaches H_{max}

to = hypothetical age at shell height zero

The size (shell height) of the scallops is shown in Fig. 3.6. Every point in the Figure represents an observation (a measured scallop), and the growth curve is calculated by means of von Bertalanffy's growth equation.

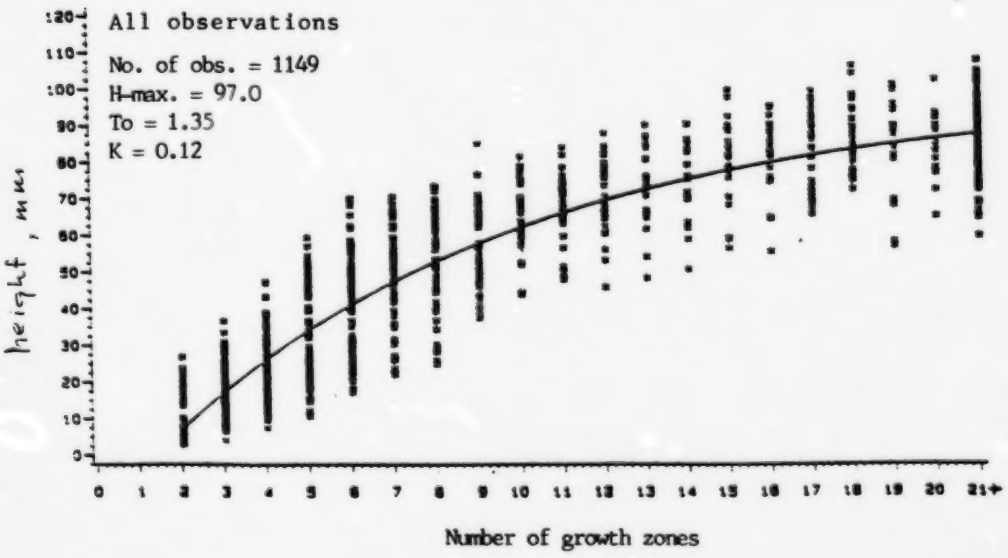


Fig. 3.6 Average size (shell height) of scallops for all age-determined scallops from the Nuuk area. The curve shows von Bertalanffy's growth function.

To study the differences occurring in growth between scallops at the different stations, growth curves were calculated for the stations and plotted in Fig. 3.7 (a + b). Table 3.6 (App.) shows the calculated constants for the parameters in von Bertalanffy's growth equation, which constitute the basis of the growth curves of Fig. 3.7 (a + b). Fig. 3.8 (a - u) (App.) shows the observations underlying the growth curves.

There are noticeable differences in the growth rates at the different localities (see Fig. 3.7 a and b, and the App. Fig. 3.8 a - u). This can be probably attributed to differences in the quantities of feed available to scallops, which in its turn can depend on differences in the local depth, temperature and current conditions.

The results of the growth studies indicate that scallops grow fastest at Station 94 (at Qegertat) and slowest at Station 64 (at Ugpik). According to the calculated growth curve, the scallops of Station 94 reach, on an average, a shell height of 82.7 mm at an age of 12 years (App., Table 3.6). At Station 64, they reach an average height of only 49.7 mm in the same time. It has been calculated that at an age of 20 years, their average shell height is 97.4 mm at Station 94 and 68.0 mm at Station 64.

The average size of the scallops was smaller at Narssaq, Ugpik, and Kobbefjord than in the other dredging areas. Age and growth studies conducted in these areas indicate that the scallops were old (20 and over), even though they were small, and therefore, growth conditions must be poor for scallops in these localities.

3.5 Weight

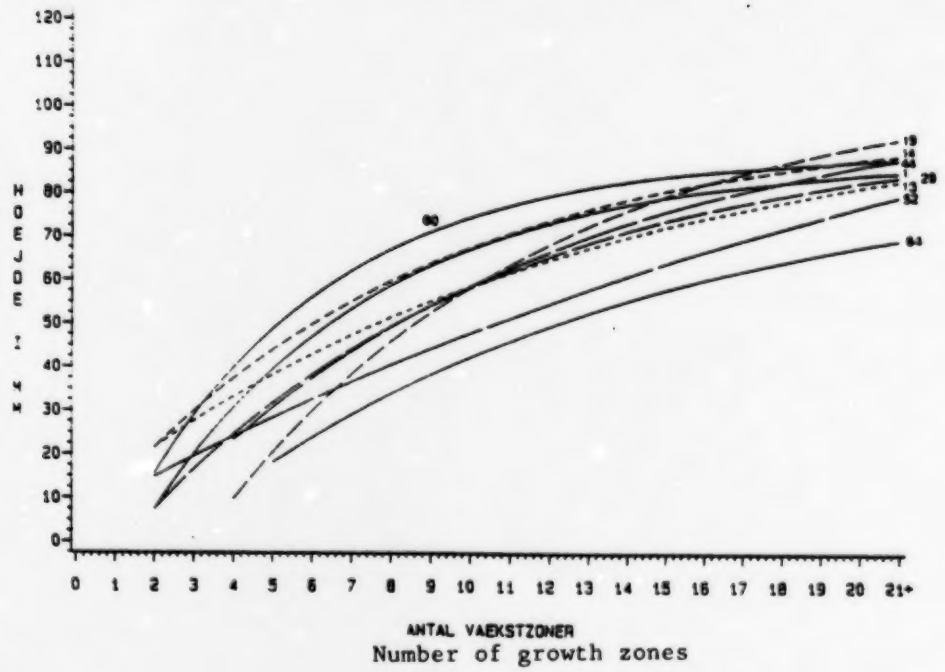
Fig. 3.9 shows the average total weight of the scallops (without barnacles etc.) as a function of shell height. The figure is based on all analyzed scallops (1149 of them) and shows the relation between total weight and shell weight, body weight, muscle weight and gonad weight. It is possible to see from the Figure, e.g., what proportion of the total weight consists of muscle weight at a given shell height. The curves shown can be expressed in mathematical terms as follows :

Total weight	:	$W = 0.000054 \quad H^{3.20}$
Shell weight	:	$W = 0.000020 \quad H^{3.32}$
Body weight	:	$W = 0.000043 \quad H^{3.04}$
Muscle weight	:	$W = 0.000020 \quad H^{3.00}$
Roe weight	:	$W = 0.000002 \quad H^{3.35}$

Table 3.7 (App.) illustrates the differences between the stations with respect to total, muscle, and gonad weight as a function of shell height.

Fig. 3.10 shows the relation between scallop age and average muscle weight for each age group. The Figure shows the values for all analyzed scallops (ALL) and for Stations 94 and 64, where the relatively highest and poorest growth rates were found. The shape of the curves indicates that average muscle weight increases with age, at least until the 16th year, after which the curve evens out.

height, mm



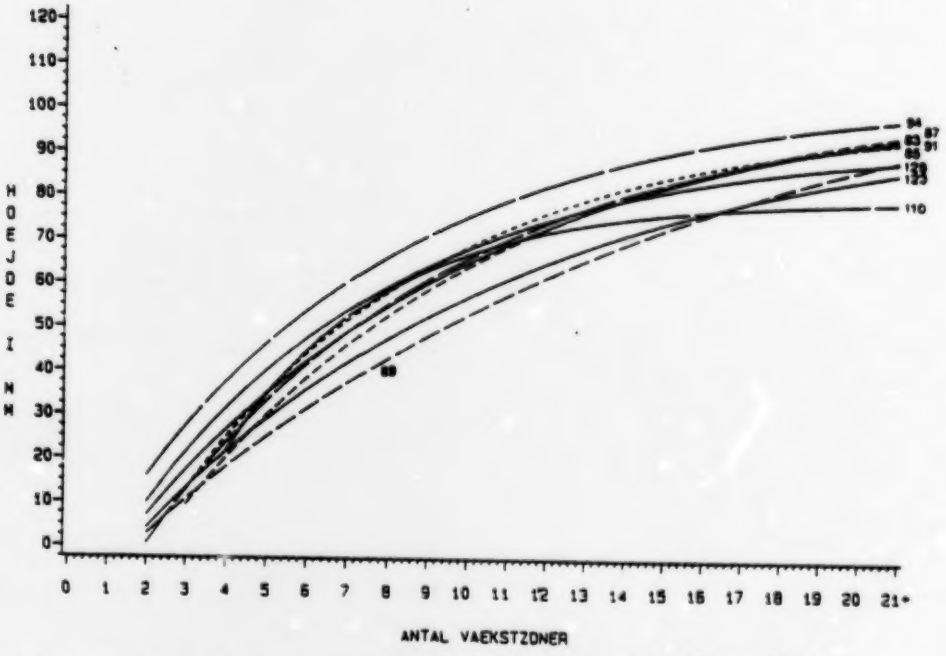


Fig. 3.7 (a and b) Growth curves calculated for scallops collected at the various dredging stations. The numbers at the curves refer to station numbers (shown in Fig. 3.2 a and b (App.)).

Figur 3.7 (a og b)

Vækstkurver beregnet for kammuslingerne indsamlet på forskellige skrabestationer. Numrene på kurverne refererer til stationsnumrene indtegnet i figur 3.2 a og b.

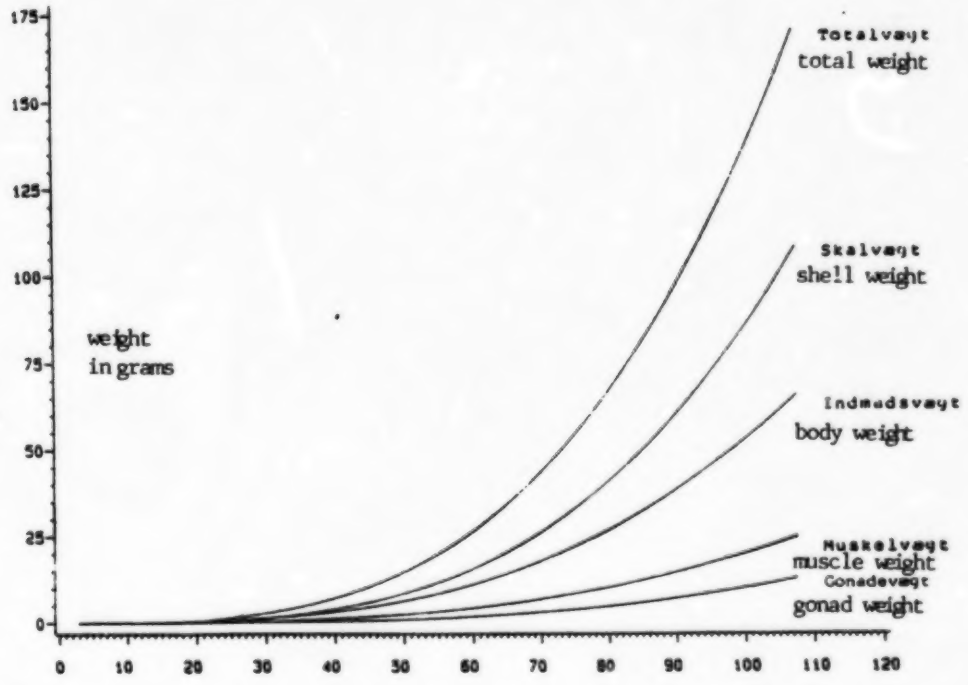


Fig. 3.9 Scallop total weight (without growths) as a function of shell height.

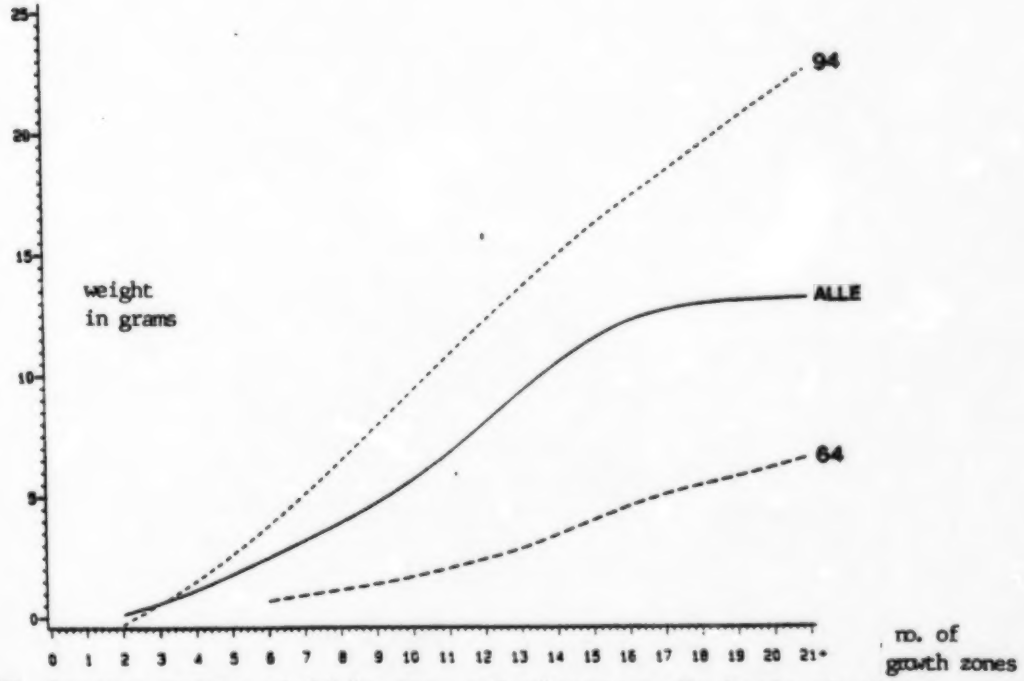


Fig. 3.10 Average muscle yield by age, calculated on the basis of all analyzed scallops (ALL) and for scallops from Stations 94 and 64.

The relation of age and average gonad weight per age group is shown in Fig. 3.11. It is seen that average gonad weight increases evenly with age approximately til the 16th year, whereafter the weight drops slightly. The values found for Stations 94 and 64 are marked in the Figure to show the range of variation between the stations.

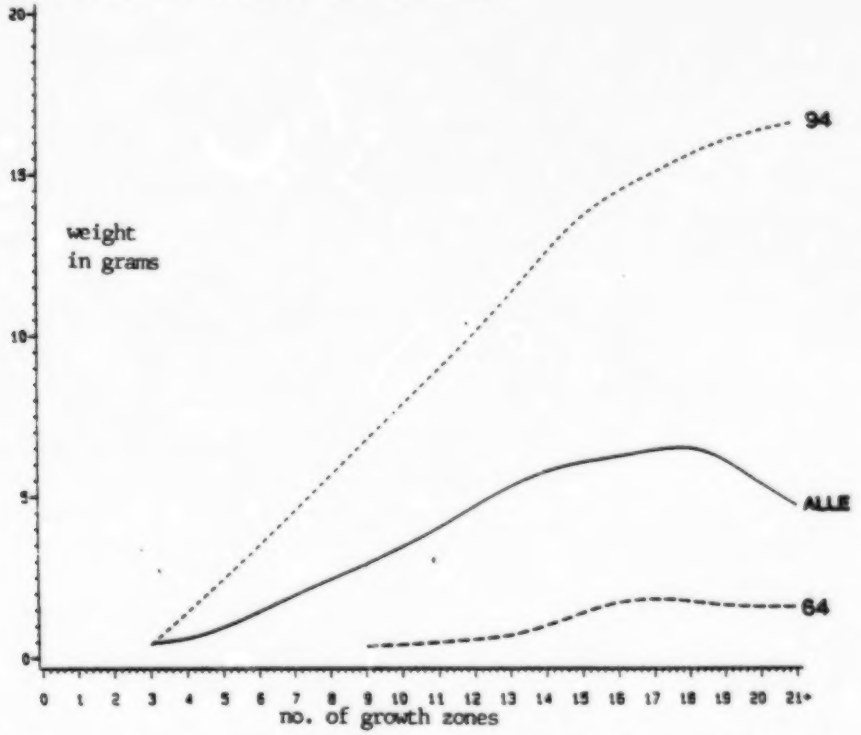


Fig. 3.11 Average gonad yield by age, calculated on the basis of all scallops analyzed (ALL) and for scallops from Stations 94 and 64.

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4. ICELANDIC SCALLOP FISHERY STATISTICS FOR THE NUUK AREA

The section below discusses the catch statistics, based on logbooks and purchasing slips collected by the Directorate of Industries.

4.1 Reported 1985 and 1986 catches

Table 4.1 is a survey of reported catches (in kg) of live Icelandic scallops from the Nuuk area, distributed by dredging locality (GFM Code, App. Fig.4.1) and year.

Table 4.1 Total catches (kg) of live scallops in the Nuuk area, distributed by dredging locality (GFM Code) and year.

GFM Code	1985	1986
JB026	-	150
JD025	-	7100
JD026	373142	111979
JD027	6600	989
JF026	58224	-
MISS	894840	319758
Total	1.332.806 kg	439.976 kg

Note : "MISS" = dredging locality not reported

The total 1985 catch was 1333 t, against only 440 t in 1986. Among the reported catches for which the dredging locality had been noted in the logbook, the majority of the catches were made in GFM Code area JD-26 in both 1985 and 1986. In 1985, dredging locality was not mentioned for 67 % of the catches reported. For 1986, it was not mentioned for 73 %.

Area	1985	1986
5	2875	5820
6	44913	850
7	178703	7719
8	105806	10435
9	-	7940
10	23555	1300
11	-	27142
12	12765	989
14	-	9000
16	58224	-
MISS	905965	368781
Total	1.332.806	439.976

Note : "MISS" = dredging locality not reported

Table 4.2 Total catches (kg) of live scallops from the Nuuk area, distributed by dredging area and year.

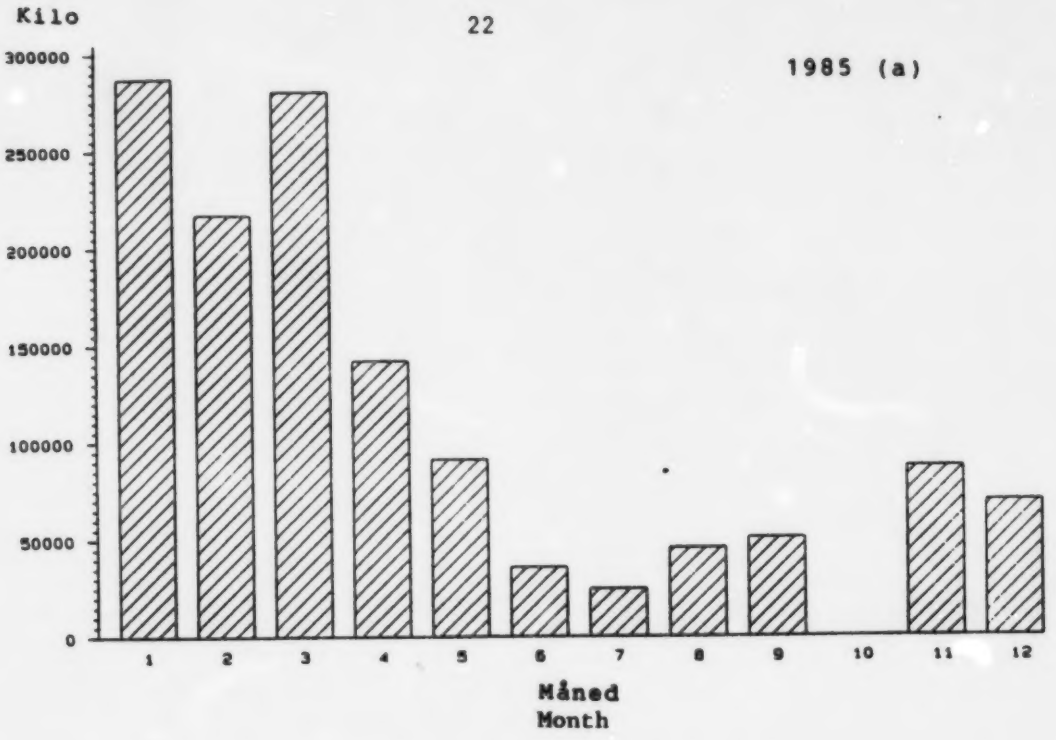
Table 4.2 refers the catches to sub-areas (App. Fig. 3.3) to make it possible to follow any deviations in fishing effort in these areas between the two years. In 1985, the majority of the scallops were taken in Area 7, while in 1986 the majority were caught in Area 11. The table has the shortcoming, however, that most of the catch can not be referred to sub-areas. Interviews with scallop fishermen revealed that the majority of the catches for which no dredging locality was mentioned, were made in area 8.

Table 4.3 Total catches (kg) of live scallop from the Nuuk area, distributed by purchasing locality, vessel, and year.

	1985	1986
Purchasing locality		
GFI Nuuk	166166	49723
KTU Paamiut	589040	-
Vessel		
Bjal Jytte	366753	319758
Bjal Junior	-	70495
Jacob Heilmann	140547	-
Sonia Kiil	-	70300
Total	1.332.806 kg	439.976 kg

The total catch in kg of live scallops, distributed by purchasing locality, vessel, and year, is shown in Table 4.3. The Table indicates i.a., that 589 t of scallops were purchased by KTU, Paamiut, in 1985.

Fig. 4.2 (a + b) shows the monthly scallop catches in 1985 and 1986. It is seen that the scallop fishery was at its peak in the first 4 months of 1985. In summer 1985, the fishery declined to below 50 t per month. Starting from November 1985, the scallop fishery increased to over 50 t per month and kept at this level until May 1986, to decline in the summer again. Thus, the scallop fishery seems to undergo a weak season during the period June to October.



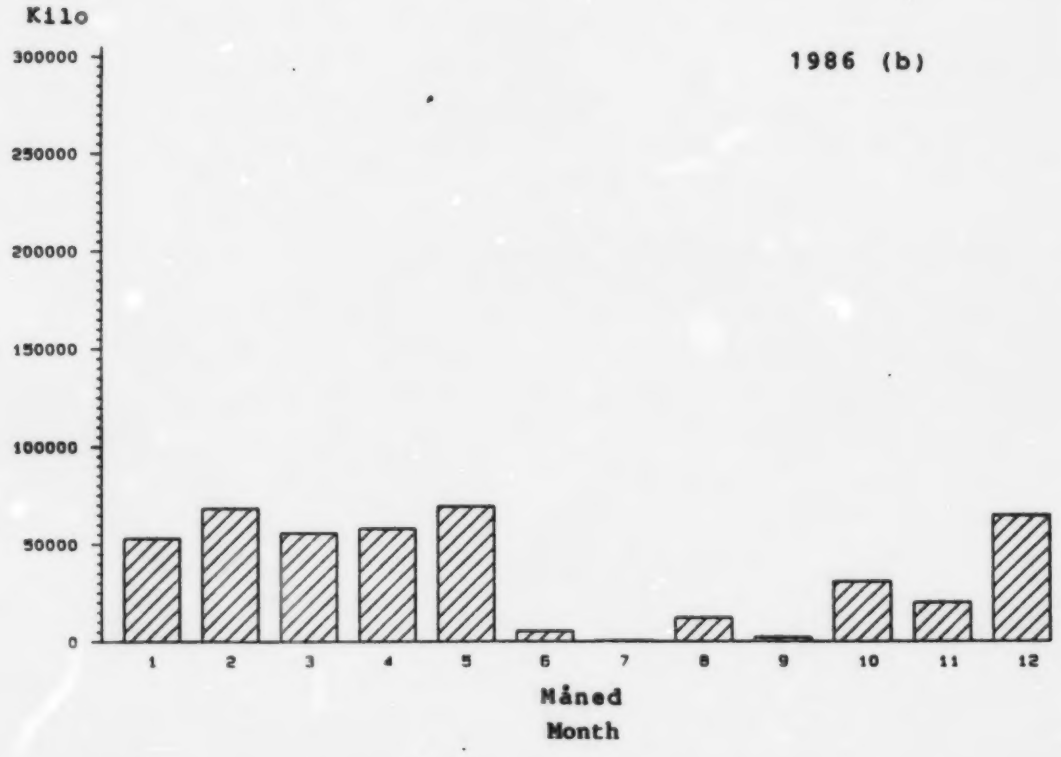


Fig. 4.2 (a and b) Monthly catches of live scallops in 1985 (a) and 1986 (b).

Figur 4.2 (a og b)

Månedsvis fangst af levende kammuslinger i 1985 (a) og i 1986 (b).

4.2 Catches per hour and per drag in 1985 and 1986

Table 4.4. (App.) shows average catches per hour and drag calculated for the dredging areas (App. Fig. 3.3) for 1985 and 1986. The calculation refers to vessels obliged to keep logbooks and it presupposes that the vessels fish uniformly, that is, that their dredges are similar and that an hour's dragging, or one drag, is of the same duration in all vessels.

The table indicates that the best catching rates were attained on grounds for which no locality is noted (MISS). The catches were, in these areas, on an average 319.41 kg per hour in 1985 and 333.69 kg per hour in 1986. Average catch per drag was 135.21 kg in 1985 and 160.34 kg in 1986.

The fishery seems to have improved from 1985 to 1986, and therefore, the catch results can not constitute the reason for the general decline in the fishery from 1985 to 1986. The increase in the catch per effort can be probably attributed to the increased efficiency of the scallop fishery; the fishermen were better at finding the best localities, and the dragging time, wire length, drag speed, etc. had been adjusted on the basis of earlier experiences.

Furthermore, the Table indicates that good catches were had in Areas 7 and 8 in both 1985 and 1986. However, catch per effort declined in Area 8. This complies with what could be expected, because the majority of the total 1985 catch was taken in Area 8.

5. SUMMARY AND CONCLUSION

5.1 Studies with R/V MISILIISOQ - spring 1987

The studies conducted with MISILIISOQ in March 1987 yielded new information about scallop beds in the Nuuk area. A new assessment of the populations is therefore now available, with respect to the biomass, size distribution, and growth rate of the Icelandic scallop in the various fishing grounds.

1. The present study estimates the population at 8651 t. This is about 4350 t less than calculated on the basis of the 1984 study (Eiriksson and Nicolajsen 1984) and must be regarded as an obvious indicator of a decline

in the population size in the Nuuk area from 1984 to 1987. It must be pointed out, however, that population estimates based on such relatively limited studies are subject to great uncertainties.

2. The size distribution of the scallops is very similar in the 1984 and 1987 studies, which means that very little recruitment has taken place. A very great majority of the scallops measure from 75 to 100 mm (see Fig. 3.4). Therefore, the scallop population in the Nuuk area can be considered an accumulation population, that is, the population consists essentially of older individuals (20 years and older; see subs. text), with a low productivity.

3. The growth studies show (see Fig. 3.6) that it takes on an average 15 years for the scallop to reach the minimum size, 65 mm. Therefore, the commercial portion of the population consists of scallops of an old age. However, great differences are found in the growth rate between the different localities. The best growing conditions have been found to occur in Qegertat in the Godthaab Fjord (Station 94), while the poorest ones have been found at Ugpik SE of Godthaab (Station 64). It is probable that only scallops enoying the best growing conditions are capable of spawning and producing young. This indicates that all scallops in the Nuuk area may be offspring produced in relatively few scallop beds, e.g. on the grounds off Qeqertat. If fishing is carried out only on grounds with spawning populations, these populations may decline so much that this on the whole impairs the possibility of recruitment to the scallop populations in the Nuuk area.

4. In brief, the scallops in the Nuuk area are judged to be a resource with a very small, highly unstable productivity. It can not be predicted when a major recruitment to the population will take place. Therefore, there is reason to fear that in a few years the scallop resources of the Nuuk area may be depleted so much that an economically profitable fishing can no longer be maintained. It will be necessary now to find new Icelandic scallop grounds.

5.2 Scallop fishery statistics for the Nuuk area

Fisheries-statistical analyses yield information about reported catches, fishing localities, and fishing effort in 1985 and 1986.

1. In 1985, the total reported catch of live Icelandic scallop was 1333 t, which was 33 t over the recommended quota. In 1986, the reported catch was 440 t, much below the quota recommended for 1986.

2. In 1985, 67 % of the catches reported were recorded in the logbooks without mention of dredging locality. For 1986, this percentage was 73. This has the unfortunate result that it is not possible to follow the development of the scallop fishery or to set up a sensible management of the resource. Therefore, it has to be emphasized strongly that in the future, dredging locality be noted in the logbook.

3. Scallop fishery effort in the Nuuk area declined essentially from 1985 to 1986, but at the same time, catch per hour and catch per drag seem to have improved.

Conclusion (= recommendation)

On the basis of the present analyses of population sizes, recruitment, and catch statistics, it is recommended that an annual fishery amounting to 10 % of the estimated population be maintained. This is equal to 850 t yearly in the Nuuk area in 1987-88.

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APPENDIX

UNEDITED TRANSLATION
For information only
TRADUCTION NON REVISEE
Information seulement

Table 3.1 Catch by a 5-min. dredge drag.
Tabel 3.1

Nuuk - området 18/3 til 31/3 1987.
Nuuk area, from 18.03 to 31.03 1987.

Træk nr Drag no.	Banke Bank	Område Area	Dybde Depth (meter)	Fangst Catch (kg)	Skaller Shells (døde muel.) (dead scallops)
57	Qegertarssuaq	1	60-43	5	ccc
58	-	1	51-62	18	
27	-	1	55-45	2	
28	-	1	37-43	140	cc
29	-	1	30-18	0	
23	-	1	50-40	125	ccc
24	-	1	65-50	0	
25	-	1	30-45	44	
26	-	1	30-45	0,5	
30	-	1	43-38	2	cc
31	-	1	50-57	50	
27	-	1	55-45	2	
Gennemsnit af træk med fangst Average catch per drag				38,9	
21	Qilangarssuit	2	80-60	0,2	c
22	-	2	60-40	0,2	ccc
Gennemsnit af træk med fangst Average catch per drag				0,2	
15	Kigtorqat	3	70-80	5	ccc
18	-	3	45-45	0,2	
19	-	3	50-60	130	cc
125	-	3	54-31	0,2	
16	-	3	40-60	35	ccc
17	-	3	50-60	25	
20	-	3	50-70	18	cc
Gennemsnit af træk med fangst Average				30,5	
63	Angissorssuaq-Akilia	4	42-32	25	
62	-	4	32-34	75	ccc
61	-	4	38-60	25	ccc
60	-	4	44-35	75	ccc
59	-	4	34-40	75	ccc
14	-	4	50-60	100	ccc
126	-	4	55-92	0	c
127	-	4	60-55	0	
128	-	4	62-49	5	ccc
Gennemsnit af træk med fangst Average				54,3	

48	Syd-Qagssissaqdlit	5	42-28	40	ccc
47	-	5	42-35	60	ccc
46	-	5	38-25	70	cc
45	-	5	27-35	2	
44	-	5	38-35	110	cc
43	-	5	45-40	2	cc
54	-	5	45-35	75	ccc
55	-	5	27-37	2	ccc
56	-	5	53-45	40	ccc
129	-	5	56-44	35	ccc
130	-	5	49-30	50	ccc
Gennemsnit af træk med fangst				44,2	

Average catch per drag

49	Aligortoq-Narssaq	6	57-61	0,2	c
50	-	6	46-38	100	ccc
124	-	6	52-44	0,2	
51	-	6	59-47	10	ccc
52	-	6	50-62	60	ccc
53	-	6	39-42	100	ccc
Gennemsnit af træk med fangst				45,1	

Average

37	Simiuta-Kingigtoq	7	50-70	0	
38	-	7	60-40	1	
39	-	7	45-55	25	ccc
40	Simiuta	7	62-55	10	cc
41	-	7	60-80	0	
42	-	7	50-43	0	
34	Simiuta-Narssaq	7	40-45	1	
32	-	7	40-27	5	cc
35	-	7	40-37	4	
33	-	7	50-35	0,2	c
36	-	7	40-36	30	
87	-	7	40-43	25	ccc
86	-	7	45-40	1	
Gennemsnit af træk med fangst				10,2	

Average

82	Syd-Naparutiligssuaq	8	30-22	0	
84	-	8	48-18	0	
83	-	8	58-46	50	ccc
75	-	8	35-42	45	ccc

72	-	8	40-38	25	ccc
85	Nord-Qagssissaqdlit	8	46-56	10	
Gennemsnit af træk med fangst				29,0	

Average catch per drag

74	Syd-Angissunguae	9	32-41	0,2	cc
71	-	9	43-56	2	cc
70	-	9	40-46	2	
69	-	9	35-39	0,2	
68	-	9	39-29	5	
67	-	9	45-41	75	ccc
Gennemsnit af træk med fangst				14,1	

Average

9	Angissunquaq	10	55-60	2	ccc
81	Pulargavit	10	60-55	0	
Gennemsnit af træk med fangst				2	

Average

6	Simiuta	11	60-65	26	ccc
7	Kingigtoq	11	65-60	41	ccc
122	-	11	40-37	40	ccc
123	-	11	40-27	50	ccc
8	Angissunquaq	11	45-65	2	ccc
Gennemsnit af træk med fangst				31,8	

Average

10	Ameralik	12	60-55	8	ccc
11	-	12	60-70	9	ccc
12	-	12	60-70	26	c
13	-	12	60-70	100	c
Gennemsnit af træk med fangst				35,8	

Average

88	Ameralik	13	60-40	15	ccc
76	Rypeø	13	30-36	45	c
77	-	13	42-32	70	c
89	Serfartoree	13	40-55	80	ccc
88	Ameralik	13	60-40	15	ccc
65	Ugpik	13	27-60	20	
66	-	13	50-41	75	cc
67	-	13	45-41	75	ccc
Gennemsnit af træk med fangst				54,3	

Average

1	Kobbefjord	14	27	72	ccc
2	-	14	22-26	0	
3	-	14	18-26	19	
4	-	14	30-40	0	
5	-	14	60	37	ccc
Gennemsnit af træk med fangst				42,7	

Average catch per drag

78	Rypeø	15	22-20	0	
79	-	15	38-40	20	c
80	Pikiutdleq	15	40-55	0	cc
Gennemsnit af træk med fangst				20,0	

Average

90	Godthåbefj-Qegertat	16	35-39	10	cc
91	-	16	41-36	30	ccc
92	-	16	36-51	35	ccc
93	-	16	60-30	45	cc
94	-	16	60-53	140	c
95	-	16	60-46	35	c
96	-	16	58-47	30	cc
97(90)	-	16	40-46	19	cc
98(91)	-	16	56-42	35	ccc
99(94)	-	16	58-48	35	ccc
Gennemsnit af træk med fangst				44,5	

Average

100	Godthåbefj.	16	55-40	0
101	-	16	75-58	0
102	-	16	35-30	0
103	-	16	41-25	0
104	-	16	54-46	0
105	Godthåbefj-Qornoq	16	32-38	0
106	-	16	29-51	0,2
107	-	16	51-30	0
108	-	16	62-54	20
109	-	16	62-59	1
110	-	16	70	25
111	-	16	55-49	5
112	-	16	70-68	0
113	-	16	45-30	2
114	-	16	29-35	0
115	-	16	68-58	0

116	-	16	71-52	0
117	-	16	40	0
118	-	16	60-68	0
119	-	16	50-35	0
120	-	16	35-25	0
121	-	16	40-51	0

Table 3.5 Total catches in numbers of scallops per dredge drag and catch area. March 18 - 31, 1987.

Træk nr Drag no.	Banke Bank	Område Area	Dybde Depth (m)	Quantity Antal <65	>=65
58	Qegertarssuaq	1	51-62	9	88
28	-	1	37-43	63	211
23	-	1	50-40	41	688
25	-	1	30-45	18	214
Samlet antal pr. størrelse Total quantity per size				131	1201
19	Kigtorqat	3	50-60	101	803
16	-	3	40-60	30	175
17	-	3	50-60	15	115
20	-	3	50-70	18	101
Samlet antal pr. størrelse Total quantity per size				164	1194
60	Angissorssuaq-Akillia	4	46-38	69	453
128	-	4	62-49	28	49
Samlet antal pr. størrelse Total				97	502
48	Syd-Qagssissaqdlit	5	42-28	99	269
47	-	5	42-35	85	331
46	-	5	38-25	18	401
44	-	5	38-35	75	895
54	-	5	45-35	78	415
129	-	5	56-44	83	175
130	-	5	49-30	62	302
Samlet antal pr. størrelse Total				500	2788
50	Aligortoq-Narssaq	6	46-38	165	526
52	-	6	50-62	122	562

Samlet antal pr. størrelse Total quantity per size				287	1088
39	Simiuta-Kingigtoq	7	45-55	16	85
36	Simiuta-Narssaq	7	40-36	20	185
87	-	7	40-43	136	119
Samlet antal pr. størrelse Total				172	389
83	Syd-Naparutiligssuaq	8	58-46	124	289
75	-	8	35-42	39	272
73	-	8	64-58	15	105
72	-	8	40-38	19	148
85	Nord-Qagssissaqdlit	8	46-56	57	70
Samlet antal pr. størrelse Total				254	884
67	Syd-Angissunguae	9	45-41	44	185
Samlet antal pr. størrelse Total				44	185
6	Simiuta	11	60-65	20	150
7	Kingigtoq	11	65-60	55	221
122	-	11	40-37	69	184
123	-	11	40-27	96	316
8	Angissunquaq	11	45-65	9	13
Samlet antal pr. størrelse Total				249	884
10	Ameralik	12	60-55	2	45
11	-	12	60-70	6	65
13	-	12	60-70	15	184

Samlet antal pr. størrelse Total quantity per size				23	294
76	Rypeø	13	30-36	20	221
77	-	13	42-32	50	402
89	Serfartorss	13	40-55	149	689
88	Ameralik	13	60-40	42	106
66	Ugpik	13	50-41	269	450
67	-	13	45-41	44	185
Samlet antal pr. størrelse Total				574	2053
1	Kobbefjord	14	27	87	266
5	-	14	60	245	295
Samlet antal pr. størrelse Total				332	561
79	Rypeø	15	38-40	18	84
Samlet antal pr. størrelse Total				18	84
90	Godthåbefjord-Qegertat	16	35-39	53	96
91	-	16	41-36	71	291
92	-	16	36-51	8	151
93	-	16	60-30	31	172
94	-	16	60-53	216	768
95	-	16	60-46	10	123
96	-	16	58-47	8	119
97(90)	-	16	40-46	39	201
98(91)	-	16	56-42	36	308
99(94)	-	16	58-48	52	203
Samlet antal pr. størrelse Total				524	2432

108+109	Godthåbsfjord-Qornoq	16	62-54	2	82
110	-	16	70	11	168
111	-	16	55-49	1	27
113	-	16	45-30	5	15
Samlet antal pr. størrelse Total				19	292

Tabel 3.6 Beregnede konstanter for parametrene i von Bertalanffy's vækstmodel, fundet ved computertilpasning af modellen til data for skalhøjde ved alder på forskellige stationer.

Stations Station No. nr.	Antal Quantity obs.	H-max H, max.	To to	K K	Calculated height at age Beregnet højde ved alder 3år	12år	20år
1	103	87.9	1.48	0.17	20.0	73.2	84.1
13	50	100.3	-1.06	0.08	27.8	65.0	81.7
14	52	96.5	-0.12	0.12	30.1	74.0	87.9
19	45	104.8	3.17	0.12	-02.2	68.5	90.9
28	51	94.7	1.24	0.11	16.7	65.7	82.7
44	45	102.1	1.39	0.10	15.2	66.8	86.2
52	60	135.9	-0.80	0.04	19.2	54.5	76.8
60	57	89.6	1.03	0.20	29.2	79.6	87.6
64	45	85.3	2.28	0.09	5.4	49.7	68.0
83	90	106.3	1.38	0.11	17.4	73.2	92.6
85	72	98.8	2.06	0.15	13.0	76.6	92.1
87	75	105.7	2.22	0.12	9.4	73.0	93.2
89	74	120.2	1.66	0.07	10.8	61.9	86.9
91	67	102.0	1.97	0.13	12.8	74.3	92.2
94	60	104.5	0.81	0.14	27.6	82.7	97.4
110	30	79.7	2.72	0.25	5.4	71.9	78.6
123	75	100.5	1.50	0.10	14.0	65.3	84.7
128	53	93.5	1.26	0.15	21.5	74.8	87.9

Table 3.6 Calculated constants for parameters in von Bertalanffy's growth model, obtained by computerization of the model to produce data on shell-height/age for various stations.

Tabel 3.7 Parametrer for total-, muskel- og rognvægt som funktion af skalhøjde, fundet ved at tilpasse det matematiske udtryk $Y=A \times X^B$ til skalhøjde-vægt data fra forskellige træksta-tioner.

Station no.	Quantity	Total weight		Quantity	Muscle weight		Quantity	Roe weight	
Station nr.	Antal	Totalvægt $Y=A\times X^B$ $A\times10^{-5}$	B	Antal	Muskelvægt $Y=A\times X^B$ $A\times10^{-5}$	B	Antal	Rognvægt $Y=A\times X^B$ $A\times10^{-6}$	B
1	100	3.55	3.31	101	1.29	3.14	82	0.11	4.04
13	48	5.52	3.20	48	1.79	3.01	36	4.26	3.10
14	49	3.89	3.29	50	2.22	2.97	41	1.49	3.37
19	39	6.53	3.14	35	3.91	2.84	26	0.28	3.76
28	46	5.31	3.21	35	1.75	3.01	33	1.65	3.31
44	44	9.02	3.09	41	6.44	2.72	34	11.75	2.90
52	33	6.02	3.17	31	1.05	3.10	.	.	.
60	56	7.14	3.15	43	1.87	3.02	37	1.08	3.49
64	44	5.89	3.18	41	2.80	2.90	32	1.16	3.37
83	57	6.89	3.15	56	2.62	2.97	43	8.63	3.07
85	40	6.76	3.17	35	3.59	2.89	34	1.44	3.49
87	29	5.43	3.22	28	2.16	3.02	27	4.99	3.21
89	55	3.30	3.31	47	1.21	3.12	39	0.44	3.62
91	57	5.34	3.20	57	2.90	2.91	56	10.85	3.06
94	57	5.74	3.20	55	1.49	3.08	49	15.43	3.00
110	29	2.32	3.39	28	2.93	3.45	.	.	.
123	39	3.78	3.30	33	9.02	3.20	30	0.72	3.63
128	49	7.67	3.12	44	2.67	2.95	42	41.97	2.68

Table 3.7 Parameters for total, muscle, and roe weight as function of shell height, obtained by applying the expression $Y = A + X^B$ to shell height data from various dredging stations.

i 1985 og 1986.

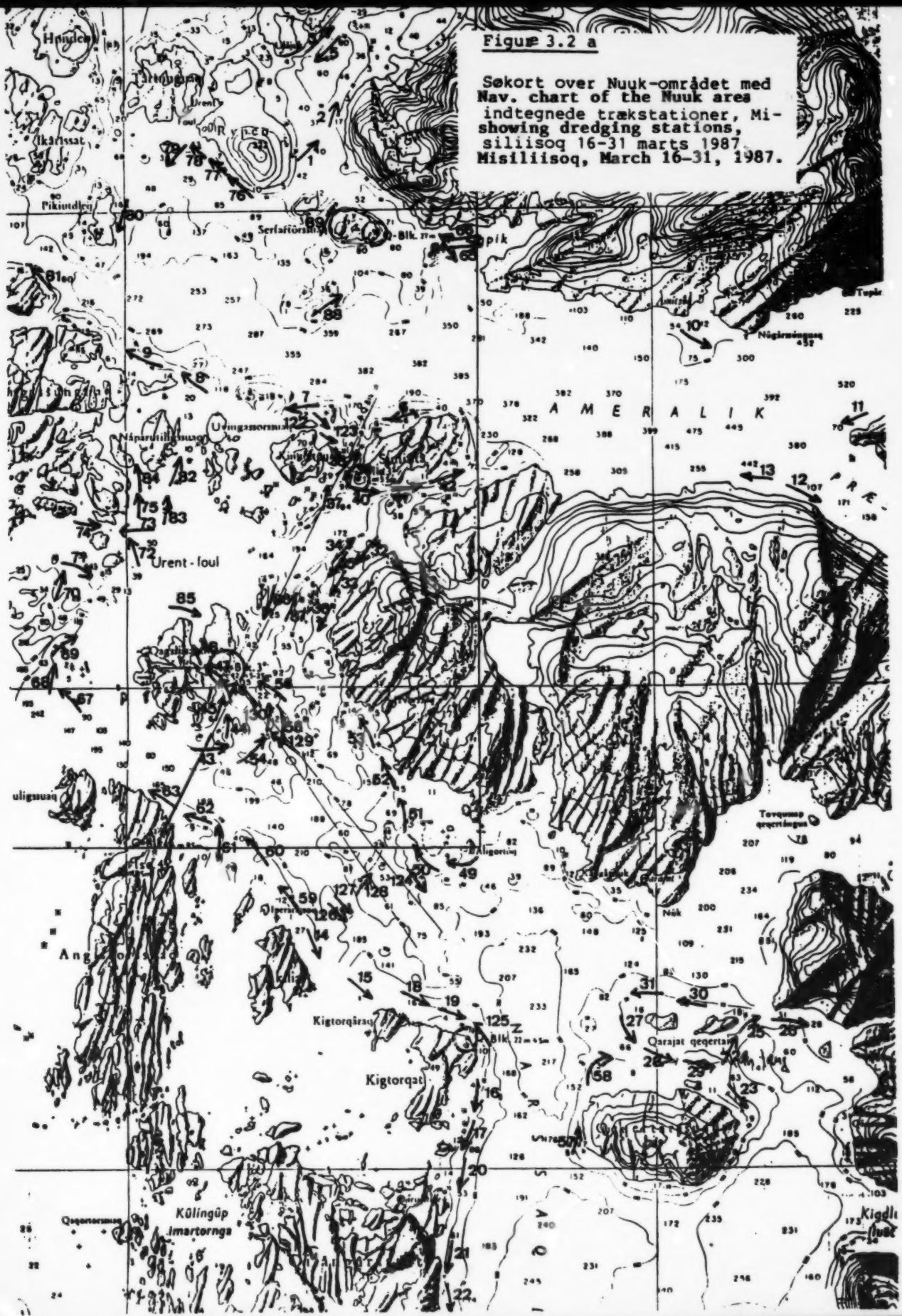
Table 4.4 Average catch per hour and per drag in each dredging area in 1985 and 1986.

	VARIABEL variable	GENNEMSNIT average	STD place	MINIMUM	MAXIMUM
	---------- ÅR=85 year		OMRÅDE=5 area	----------	
	FANGST PR TIME	95.96	9.44	83.33	104.55
	FANGST PR TRÆK	50.19	4.93	45.83	56.82
	---------- ÅR=85		OMRÅDE=6	----------	
C. per hr	FANGST PR TIME	185.34	86.84	71.88	400.00
C. per dr.	FANGST PR TRÆK	87.22	44.51	27.38	218.18
	---------- ÅR=85		OMRÅDE=7	----------	
hour	FANGST PR TIME	229.71	113.30	34.80	825.00
drag	FANGST PR TRÆK	98.13	39.21	22.12	224.25
	---------- ÅR=85		OMRÅDE=8	----------	
hour	FANGST PR TIME	237.58	114.87	0.00	492.86
drag	FANGST PR TRÆK	115.24	38.34	64.40	175.37
	---------- ÅR=85		OMRÅDE=10	----------	
	FANGST PR TIME	363.24	19.61	344.12	382.35
	FANGST PR TRÆK	.	.	.	.
	---------- ÅR=85		OMRÅDE=12	----------	
	FANGST PR TIME	228.28	95.41	109.09	398.33
	FANGST PR TRÆK	97.98	25.14	66.67	127.27
	---------- ÅR=85		OMRÅDE=16	----------	
	FANGST PR TIME	195.71	78.29	2.15	375.00
	FANGST PR TRÆK	119.97	64.62	71.43	300.00

VARIABEL	GENNEMSNIT	STD	MINIMUM	MAXIMUM
---------- ÅR=85	OMRÅDE=19 ----------			
C. per hour FANGST PR TIME	297.33	150.22	57.50	544.33
-n-drag FANGST PR TRÆK	137.46	66.00	35.38	241.62
---------- ÅR=85	OMRÅDE=MISS ----------			
FANGST PR TIME	319.41	103.81	19.05	612.50
FANGST PR TRÆK	135.21	25.66	83.33	183.70
---------- ÅR=86	OMRÅDE=3 ----------			
FANGST PR TIME	155.56	0	155.56	155.56
FANGST PR TRÆK	87.50	0	87.50	87.50
---------- ÅR=86	OMRÅDE=5 ----------			
FANGST PR TIME	163.03	94.19	92.22	350.33
FANGST PR TRÆK	99.67	65.91	44.23	210.20
---------- ÅR=86	OMRÅDE=6 ----------			
FANGST PR TIME	83.33	17.41	66.67	100.00
FANGST PR TRÆK	39.58	15.23	25.00	54.17
---------- ÅR=86	OMRÅDE=7 ----------			
FANGST PR TIME	225.96	153.21	65.00	500.00
FANGST PR TRÆK	129.36	92.41	37.50	250:00
---------- ÅR=86	OMRÅDE=8 ----------			
FANGST PR TIME	187.87	96.22	56.18	400.00
FANGST PR TRÆK	92.11	39.70	44.14	200.00
---------- ÅR=86	OMRÅDE=9 ----------			
FANGST PR TIME	109.37	33.24	52.63	158.75
FANGST PR TRÆK	80.91	44.35	41.67	187.50

C. per hour
-"- drag

VARIABEL	GENNEMSNIT	STD	MINIMUM	MAXIMUM
---------- ÅR=86		OMRÅDE=10	----------	
FANGST PR TIME	80.00	0	80.00	80.00
FANGST PR TRÆK	75.00	0	75.00	75.00
---------- ÅR=86		OMRÅDE=11	----------	
FANGST PR TIME	212.20	204.57	42.86	1120.00
FANGST PR TRÆK	90.42	84.17	20.00	466.67
---------- ÅR=86		OMRÅDE=12	----------	
FANGST PR TIME	131.87	0	131.87	131.87
FANGST PR TRÆK	109.89	0	109.89	109.89
---------- ÅR=86		OMRÅDE=14	----------	
FANGST PR TIME	236.04	85.27	155.56	366.67
FANGST PR TRÆK	113.33	18.56	87.50	129.41
---------- ÅR=86		OMRÅDE=MISS	----------	
FANGST PR TIME	333.69	131.63	75.00	900.00
FANGST PR TRÆK	160.34	59.82	30.63	375.00



Figur 3.2 a

Søkort over Nuuk-området med indtegnede trækstationer, Mi-
Nav. chart of the Nuuk ares showing dredging stations,
siliisoq 16-31 marts 1987
Misiliisoq, March 16-31, 1987.

Figure3.2 b

Søkort over Godthåbsfjorden med indtegnede trækstationer, Misiliisoq 16-31 marts 1987.

Nav. chart of Godthaab Fjord, showing dredging stations, Misiliisoq, March 16-31, 1987.

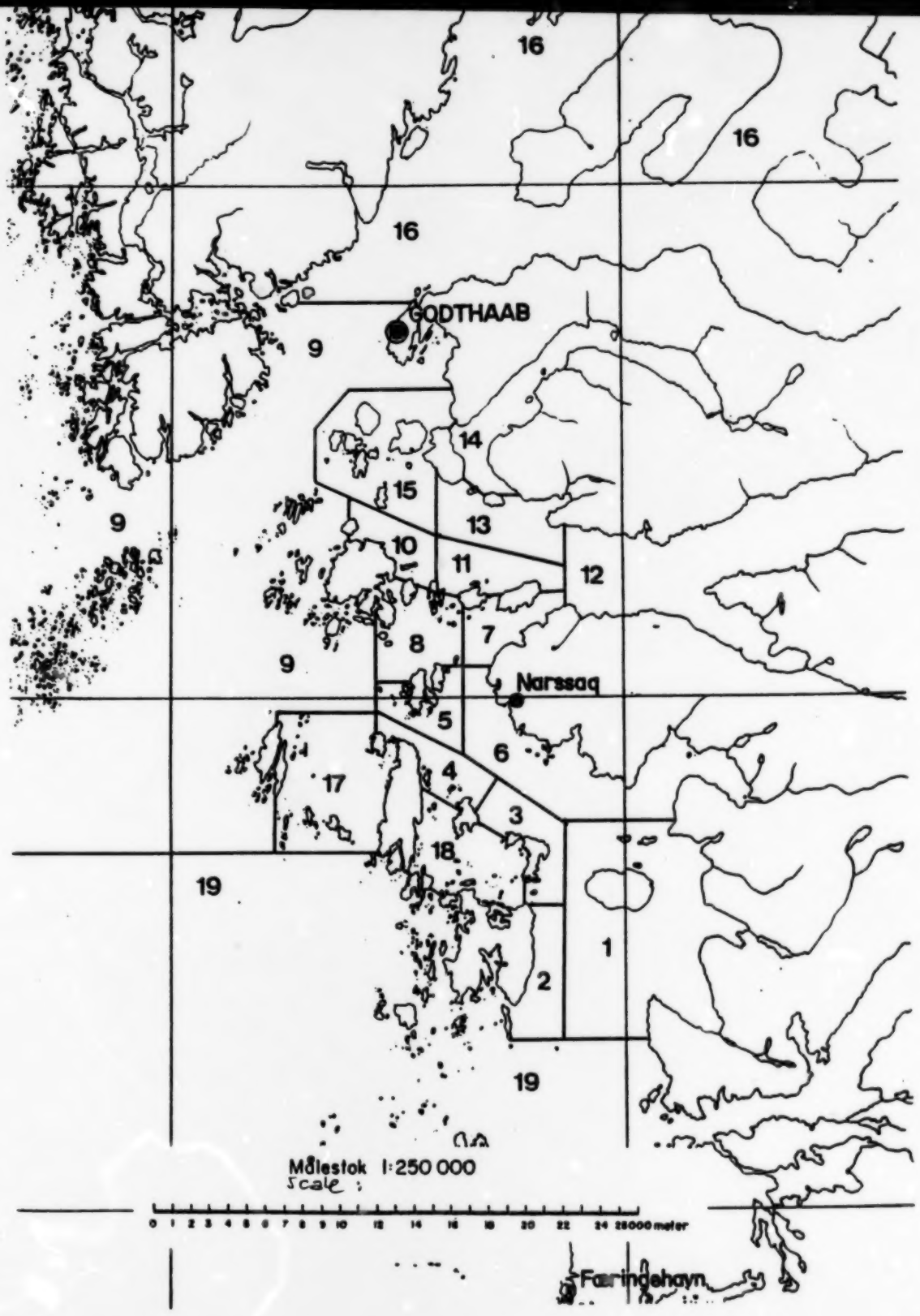
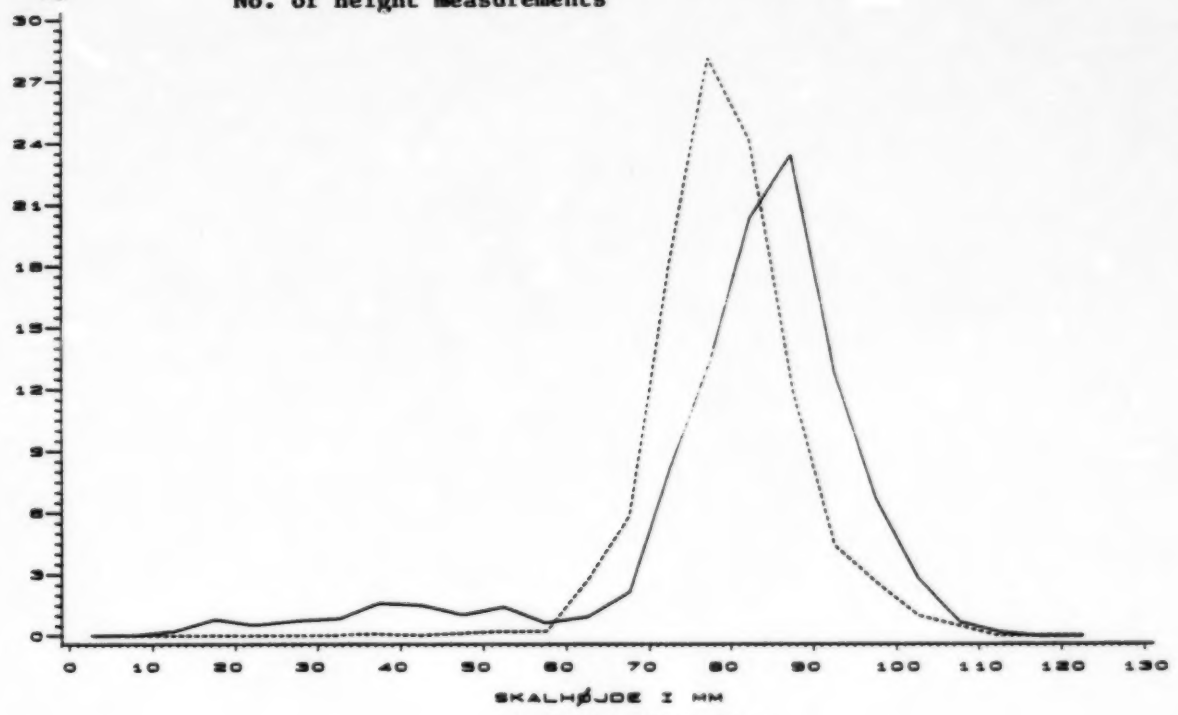


Figure 3.3 Feltopdeling af Nuuk-området.
Division of the Nuuk area.

AREA 1 **OMRÅDE 1 (QEQERTARSSUAQ)**

ANTAL HØJDEMÅLTE : 1987=1332 1984=812 **a**

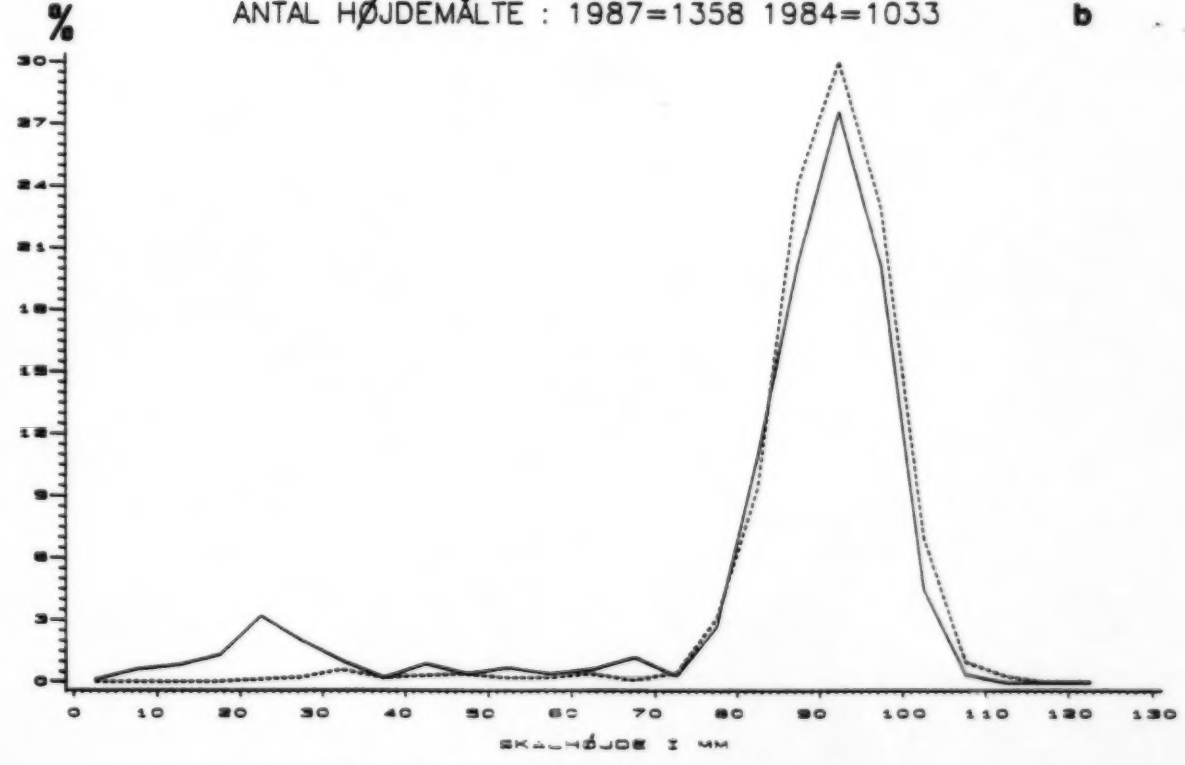
No. of height measurements



shell height in mm

AREA 3 **OMRÅDE 3 (KIGTORQAT)**

ANTAL HØJDEMÅLTE : 1987=1358 1984=1033 **b**



FULDT OPTRUKKET=1987 STIPLET=1984

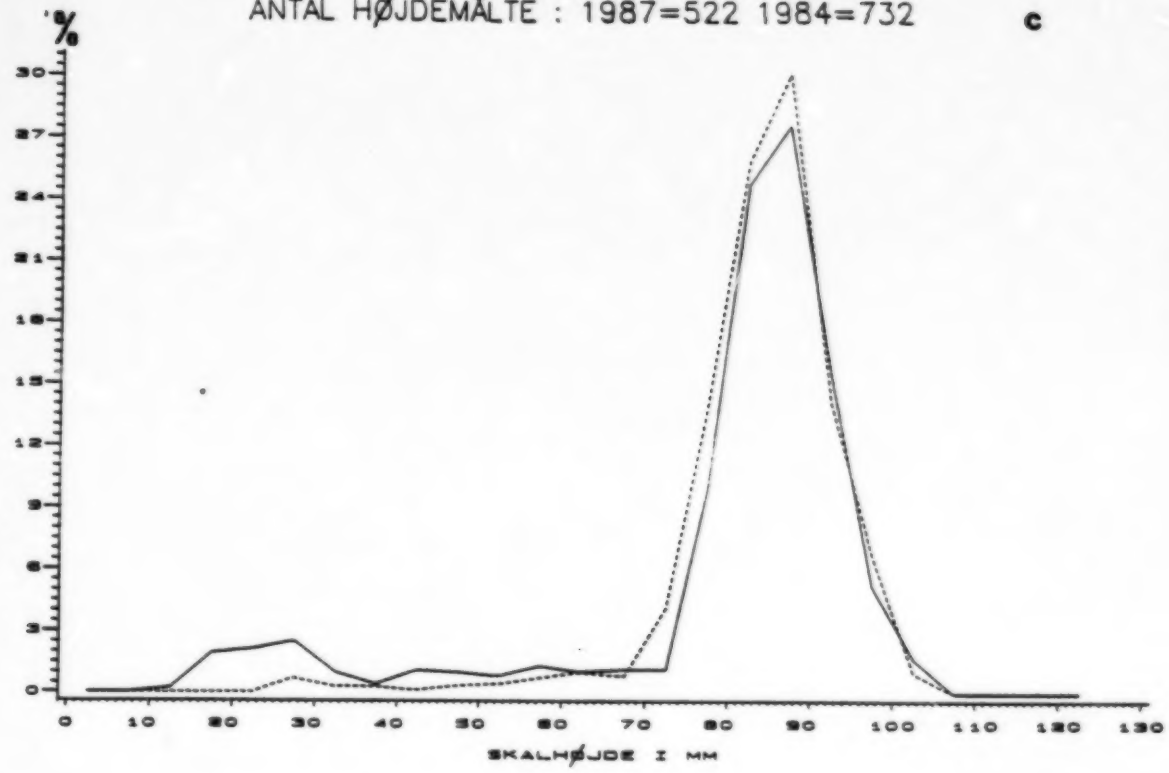
——— = **1987** - - - - = **1984**

AREA 4

OMRÅDE 4 (ANGISSORSSUAQ)

ANTAL HØJDEMÅLTE : 1987=522 1984=732

c

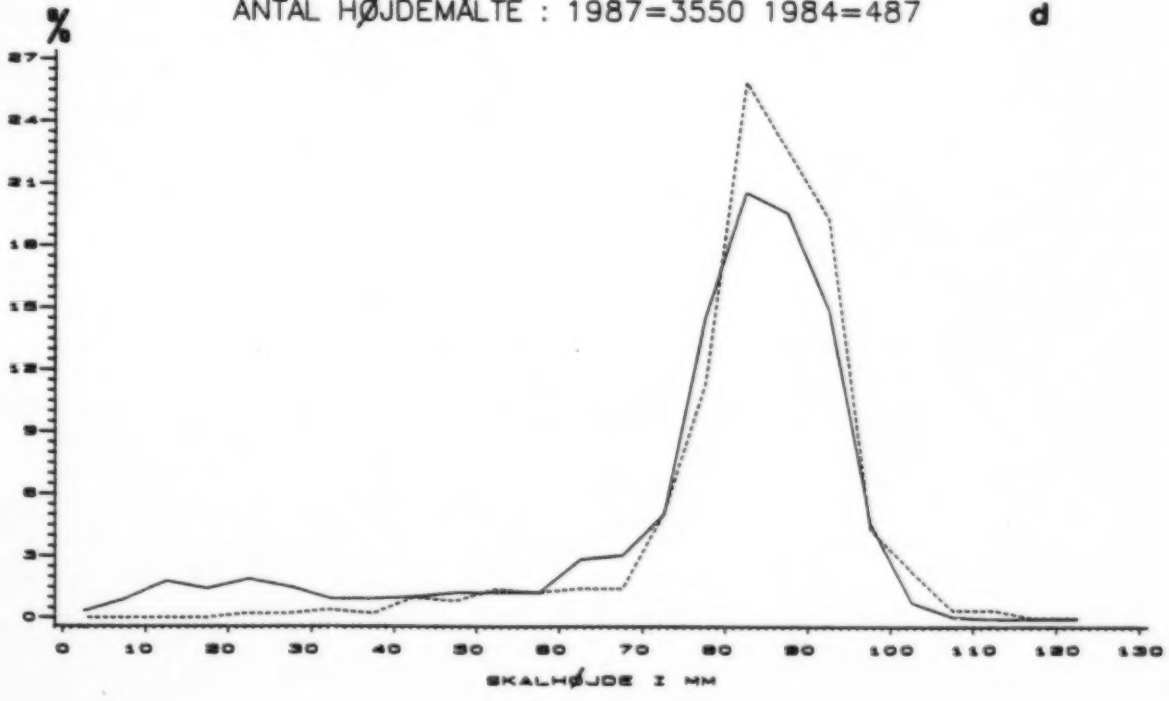


AREA 5

OMRÅDE 5 (QAGSSISSAGDLIT)

ANTAL HØJDEMÅLTE : 1987=3550 1984=487

d

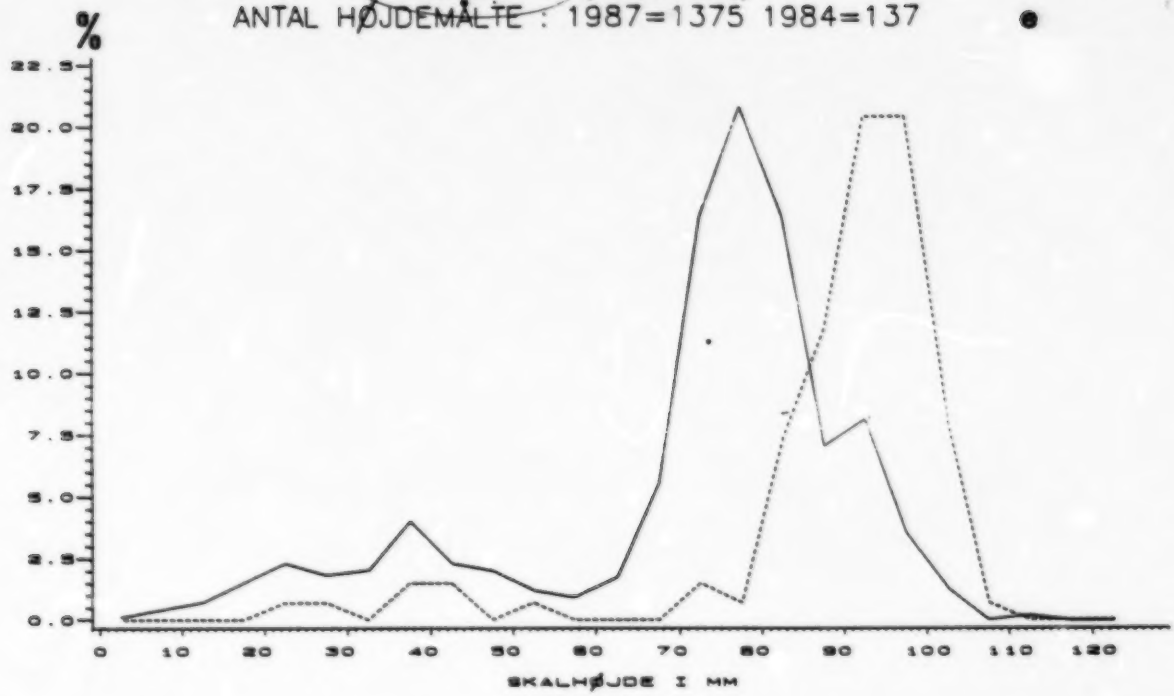


FULDT OPTRUKKET=1987 STIPLET=1984

OMRÅDE 6 (NARSSAQ)

ANTAL HØJDEMÅLTE : 1987=1375 1984=137

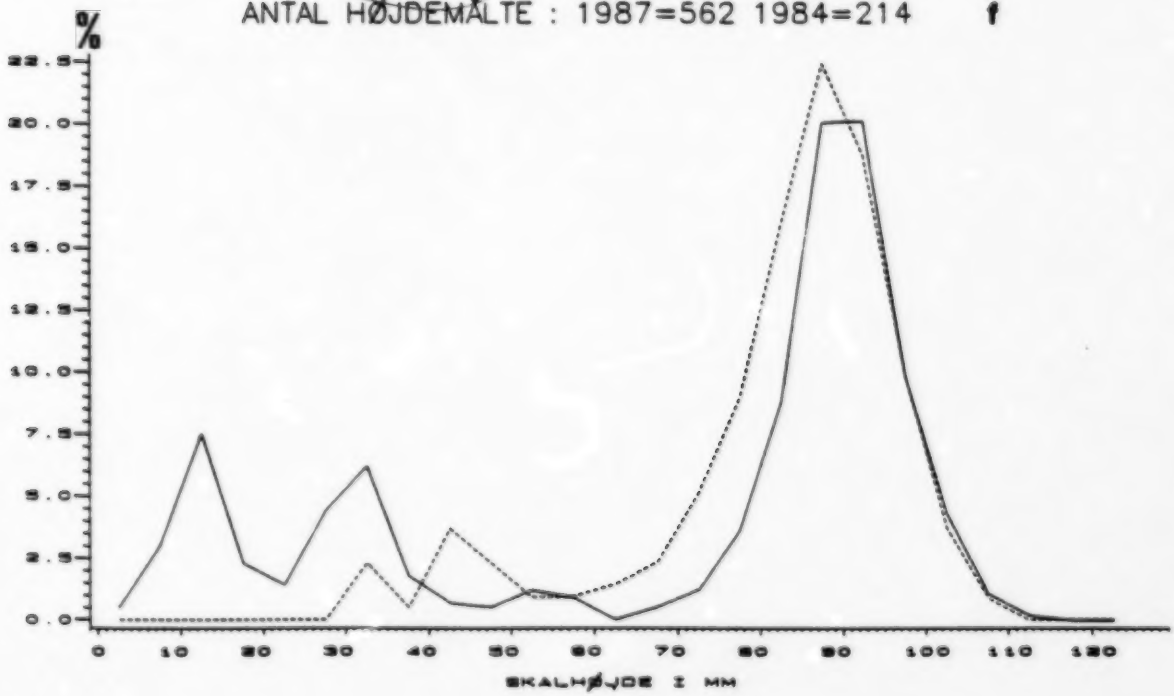
e



OMRÅDE 7 (SYD FOR SIMIUTA)

ANTAL HØJDEMÅLTE : 1987=562 1984=214

f

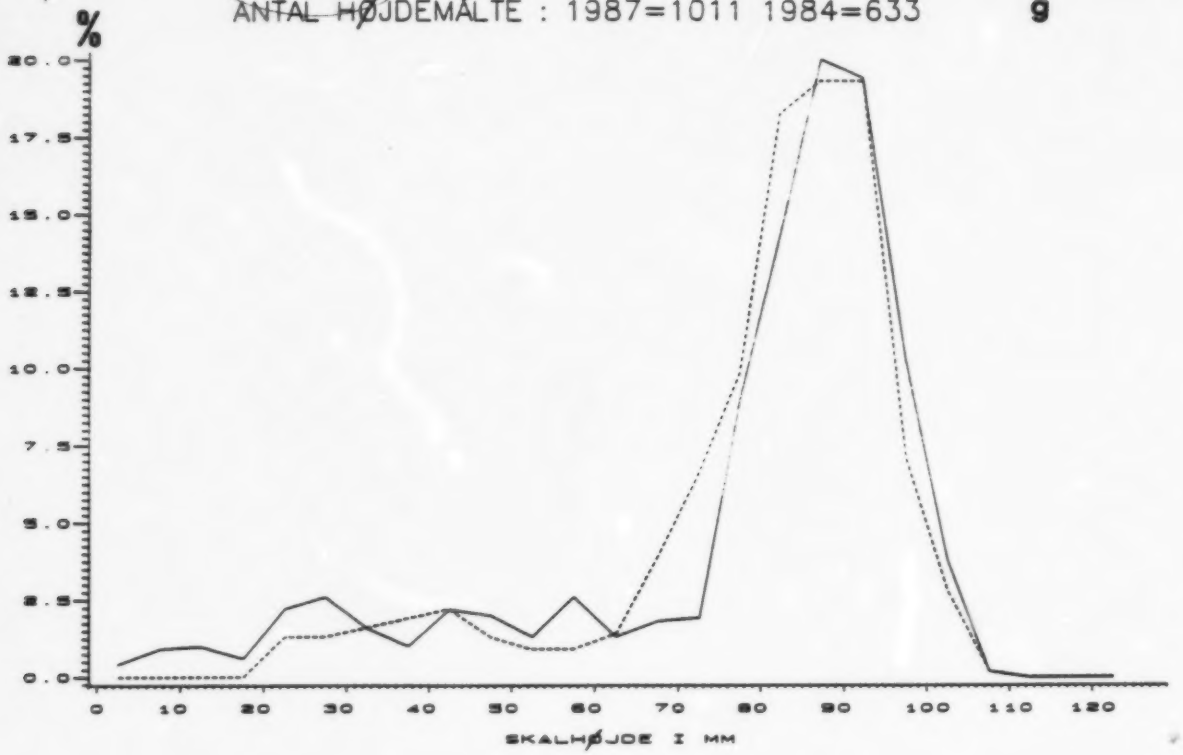


FULDT OPTRUKKET=1987 STIPLET=1984

OMRÅDE 8 (SYDØST FOR ANGISSUUNGUAQ)

ANTAL HØJDEMÅLTE : 1987=1011 1984=633

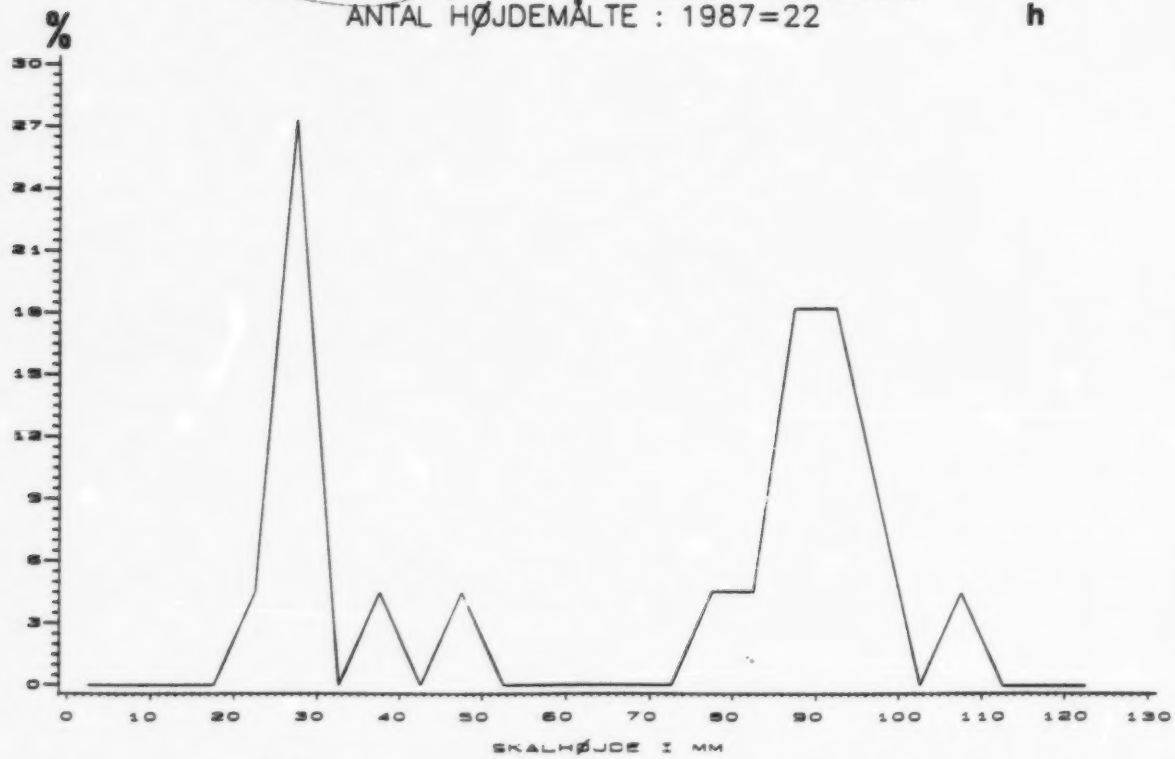
g



OMRÅDE 10 (NORD FOR ANGISSUUNGUAQ)

ANTAL HØJDEMÅLTE : 1987=22

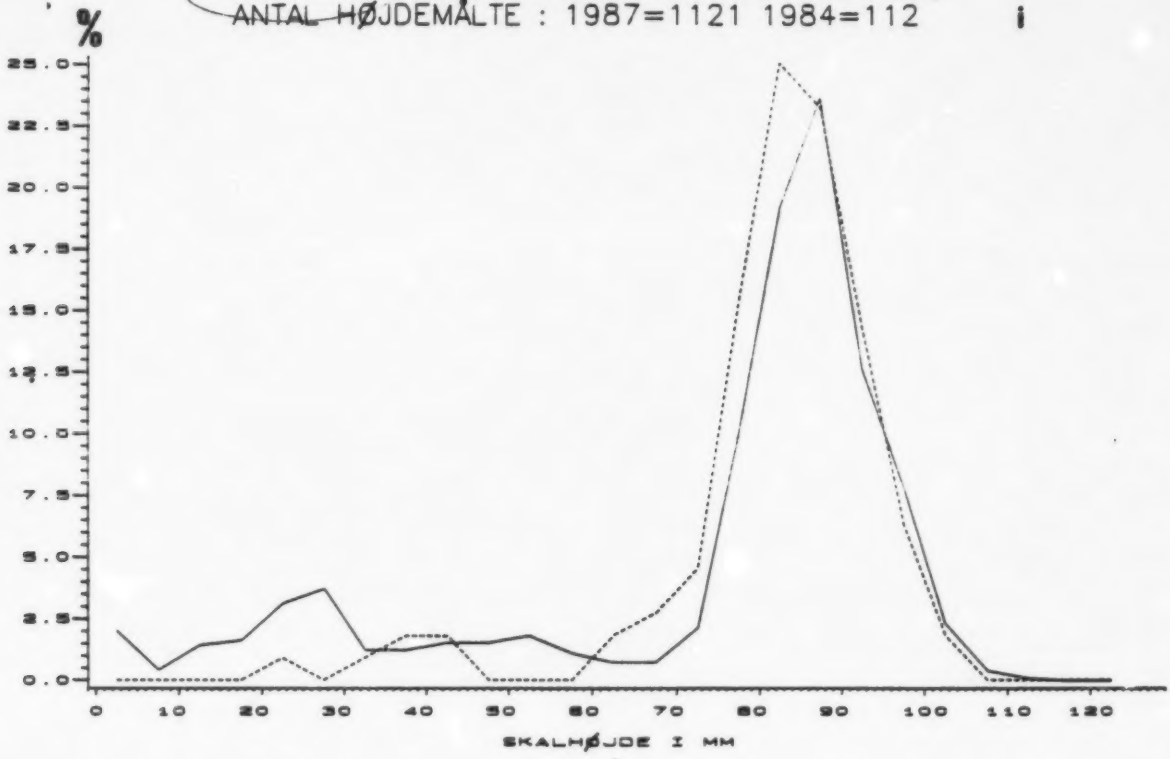
h



FULDT OPTRUKKET=1987 STIPLET=1984

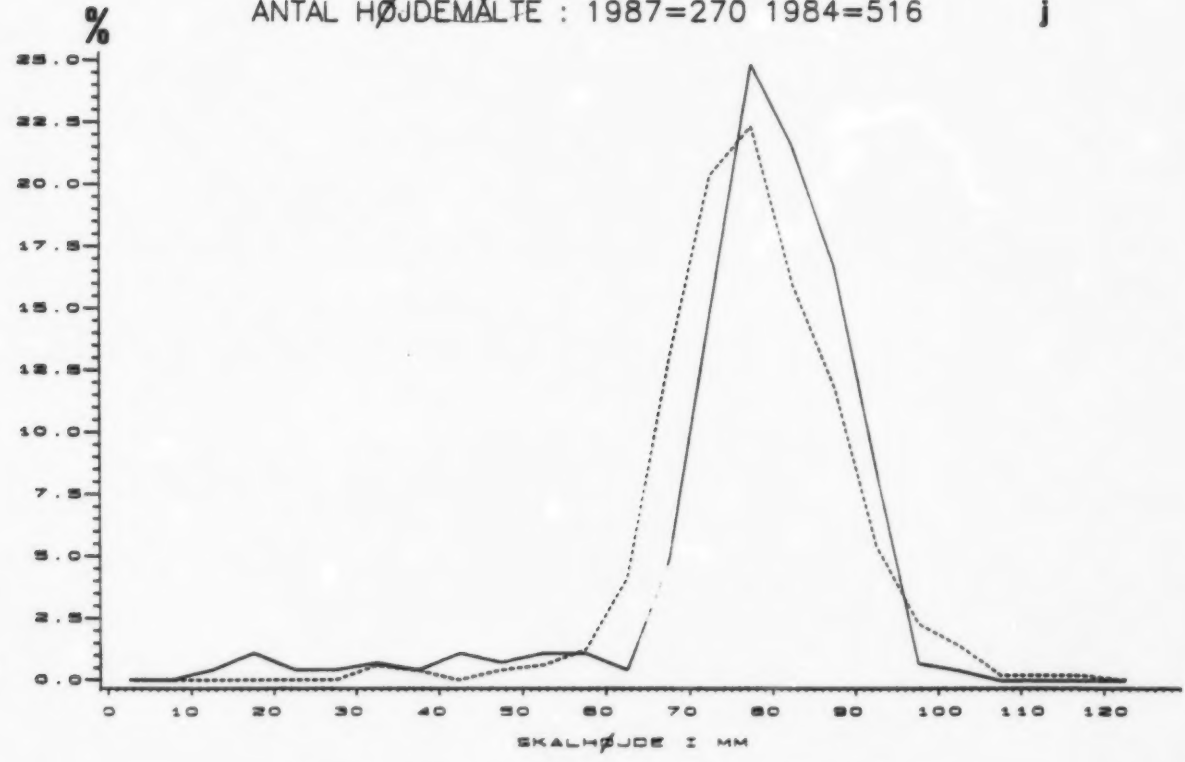
OMRÅDE 11 (NORD FOR KINGIGTOQ-SIMIUTA)

ANTAL HØJDEMÅLTE : 1987=1121 1984=112 i



OMRÅDE 12 (PRÆSTEFJORD)

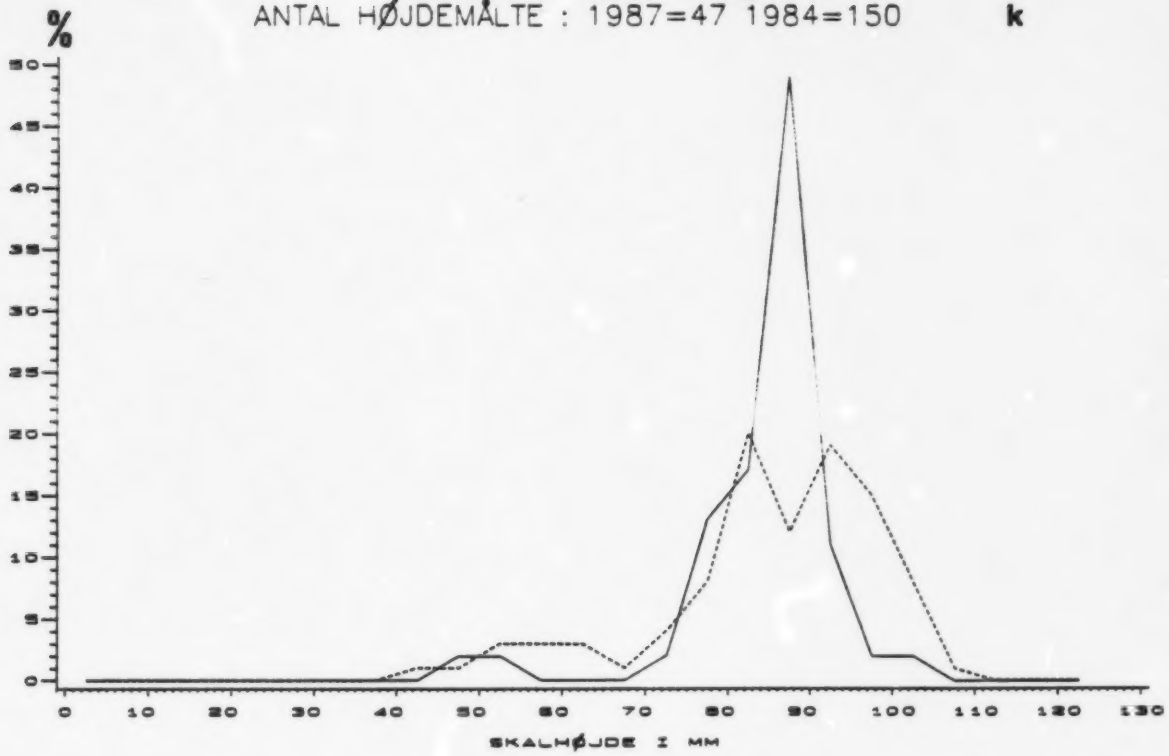
ANTAL HØJDEMÅLTE : 1987=270 1984=516 j



FULDT OPTRUKKET=1987 STIPLET=1984

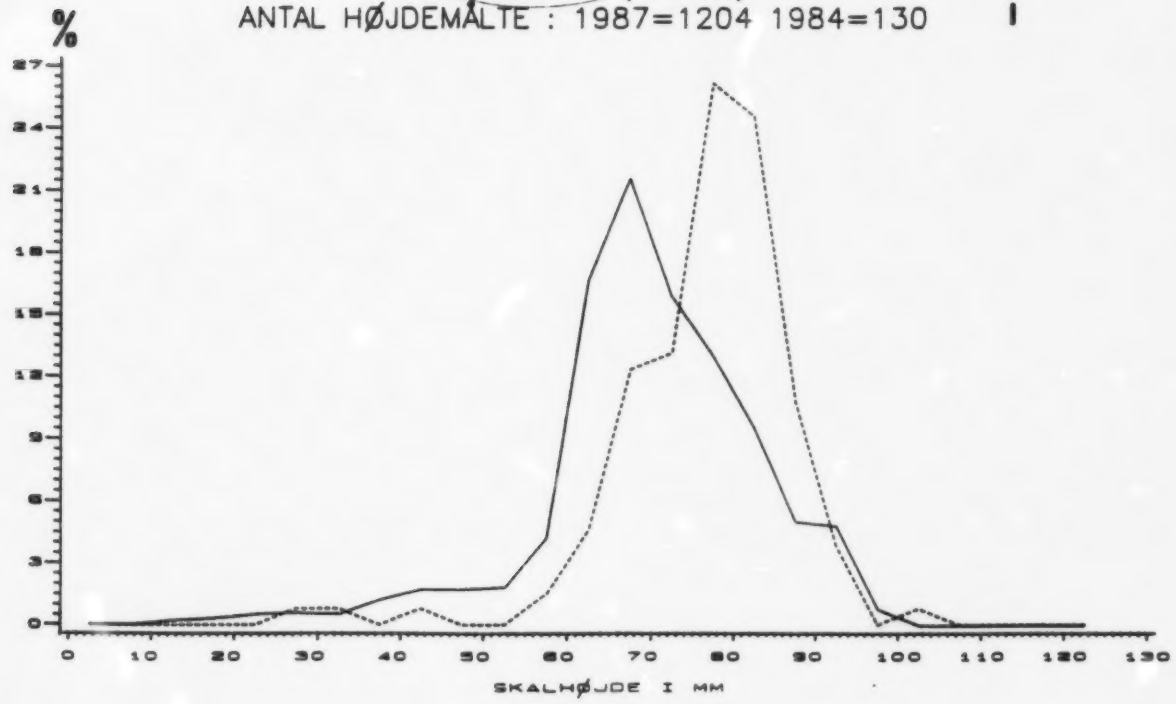
OMRÅDE 12 (AMITSOQ)

ANTAL HØJDEMÅLTE : 1987=47 1984=150 k



OMRÅDE 13 (UGPIK)

ANTAL HØJDEMÅLTE : 1987=1204 1984=130 l



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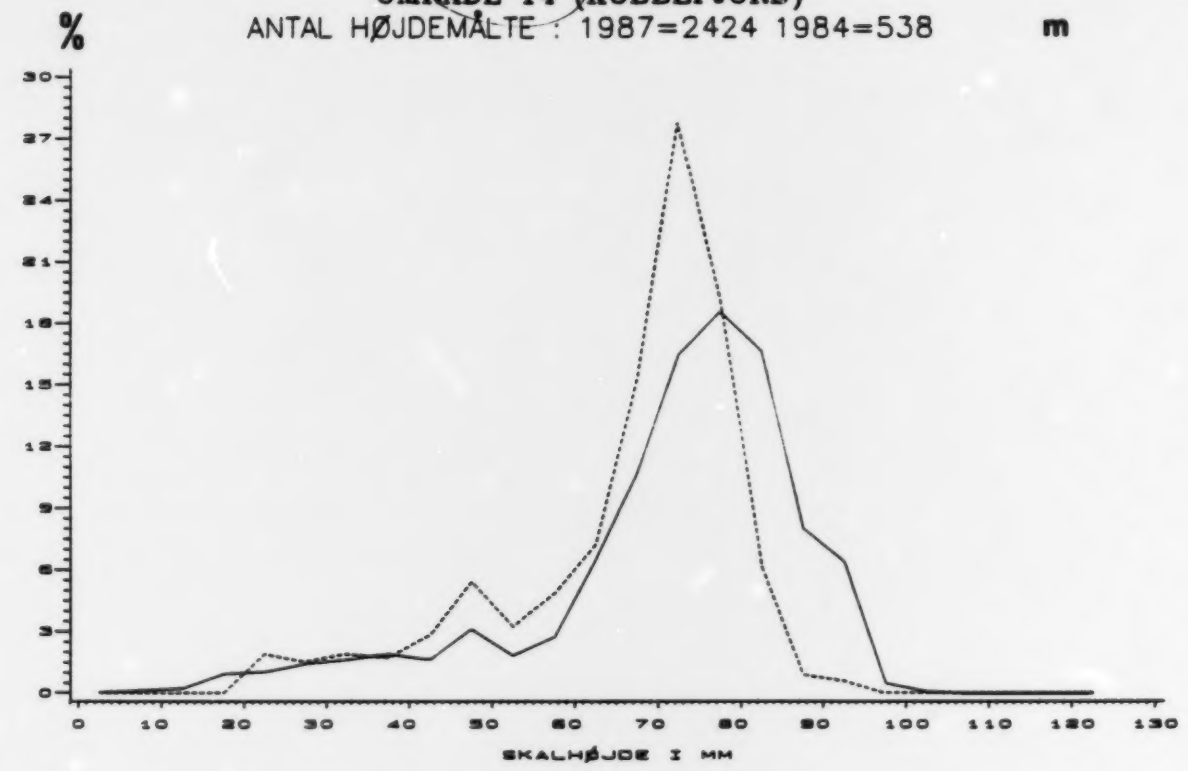
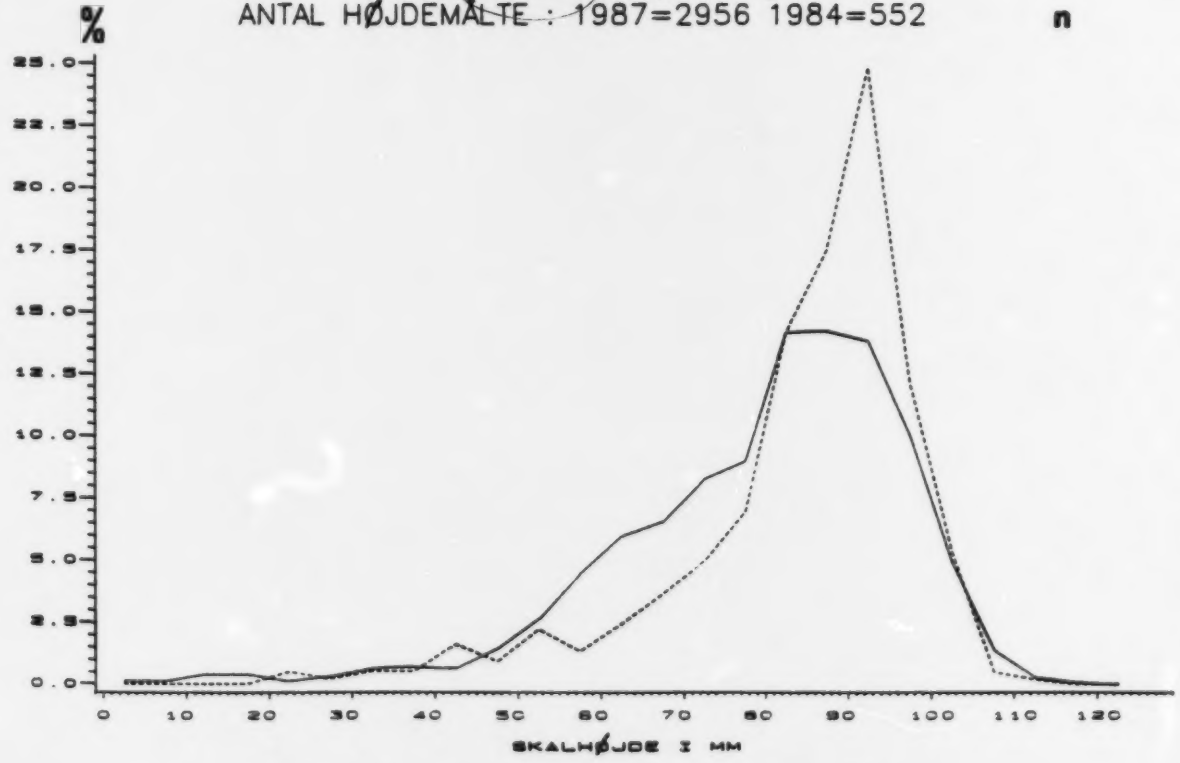
OMRÅDE 14 (KOBBEFJORD)

ANTAL HØJDEMÅLTE : 1987=2424 1984=538



OMRÅDE 16 (QEQERTAT)

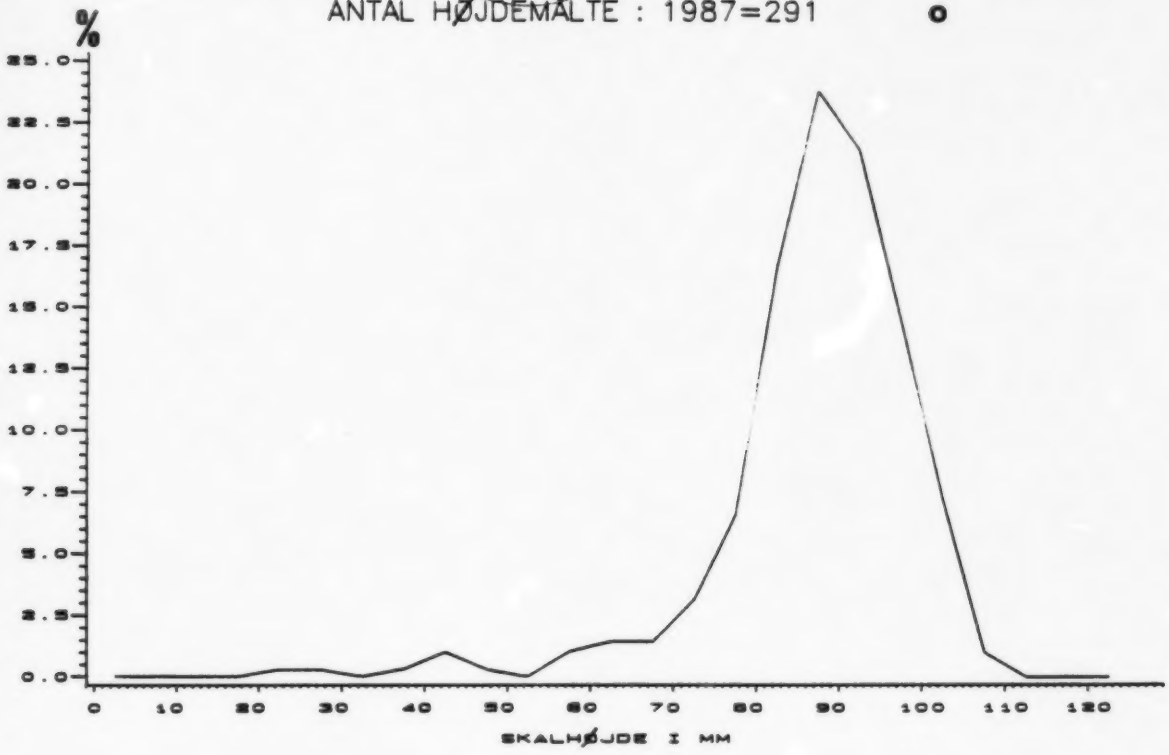
ANTAL HØJDEMÅLTE : 1987=2956 1984=552



FULDT OPTRUKKET=1987 STIPLET=1984

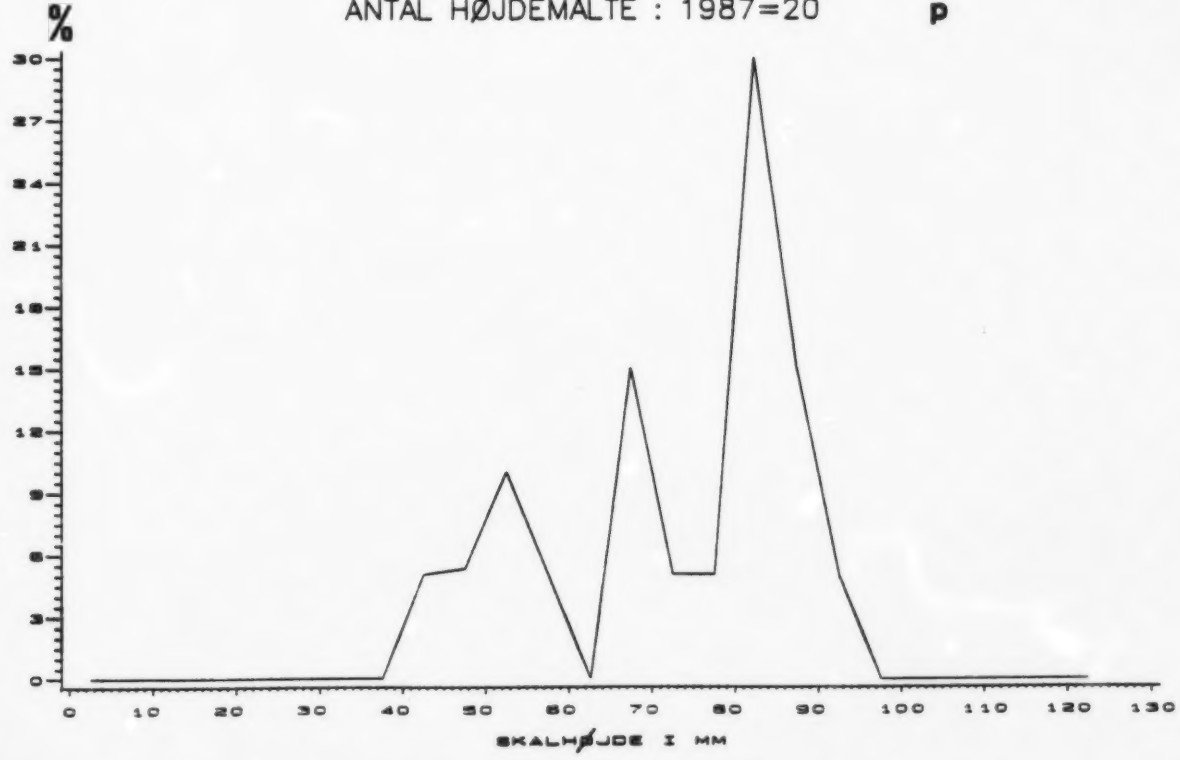
OMRÅDE 16 (QORNOQ)

ANTAL HØJDEMÅLTE : 1987=291 o

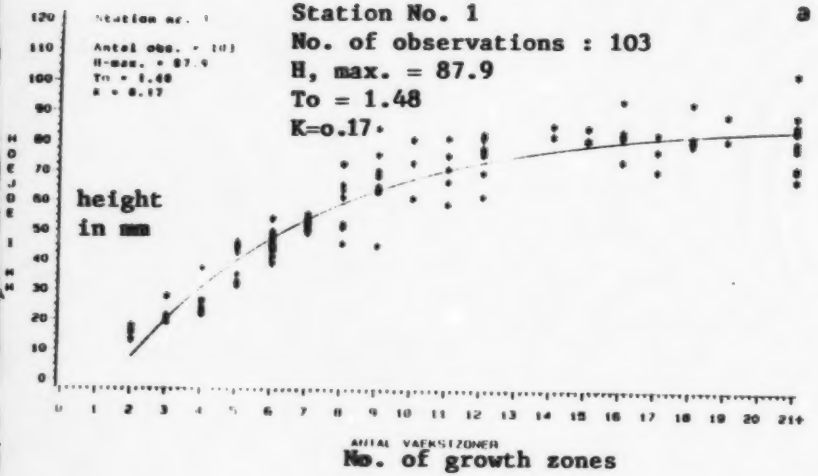


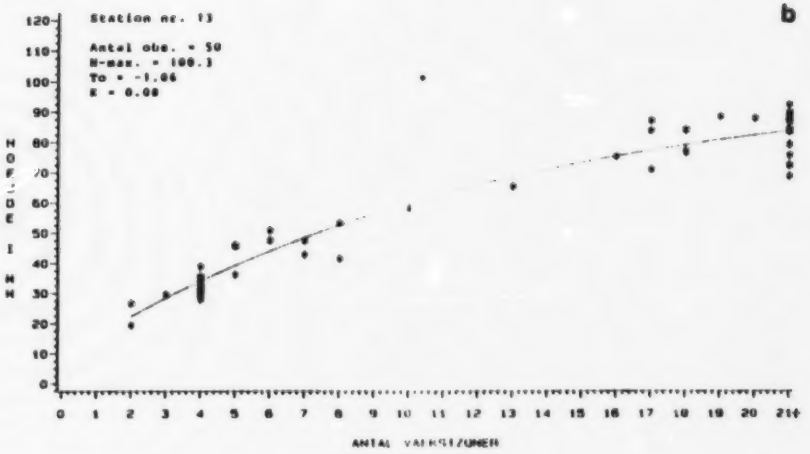
OMRÅDE 16 (UMANAQ)

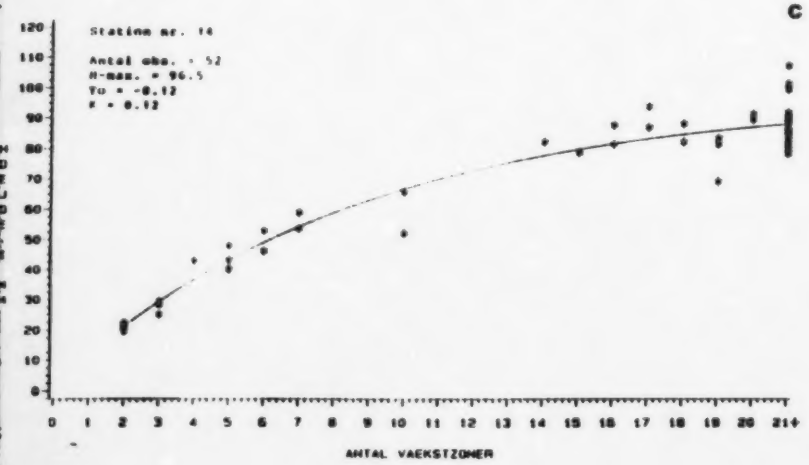
ANTAL HØJDEMÅLTE : 1987=20 p

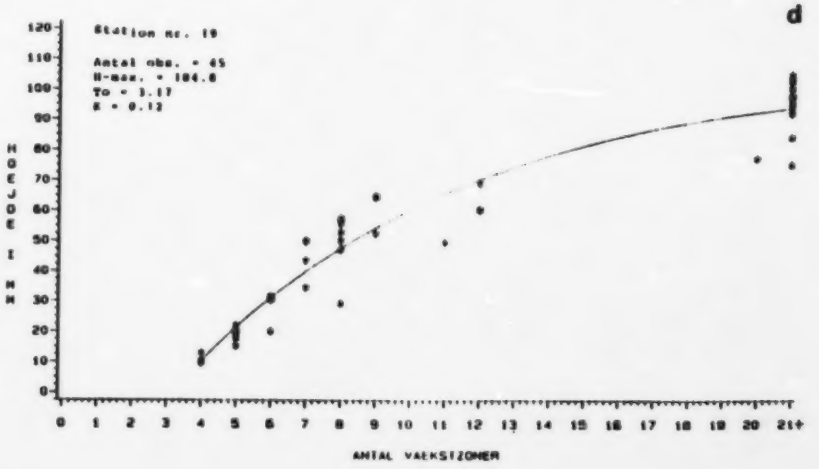


FULDT OPTRUKKET=1987 STIPLET=1984

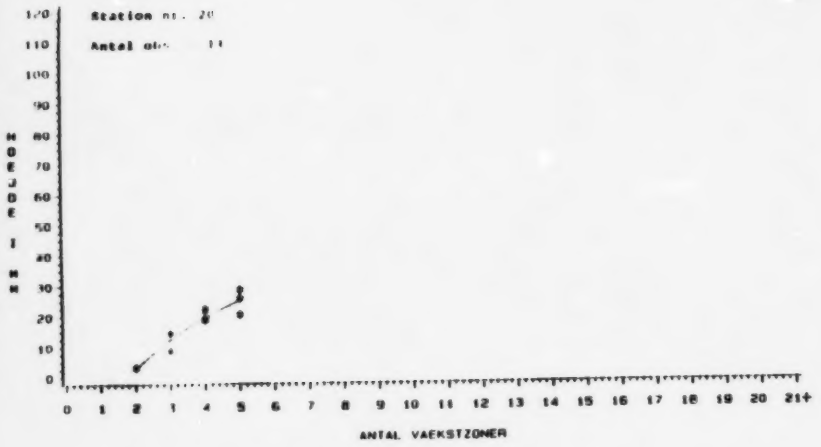

Station No. 1
No. of observations : 103
H, max. = 87.9
To = 1.48
K=o.17.
a
height
in mm
ANTAL VAEKSTZONER
No. of growth zones


b
ANTAL VAEKSTZONER

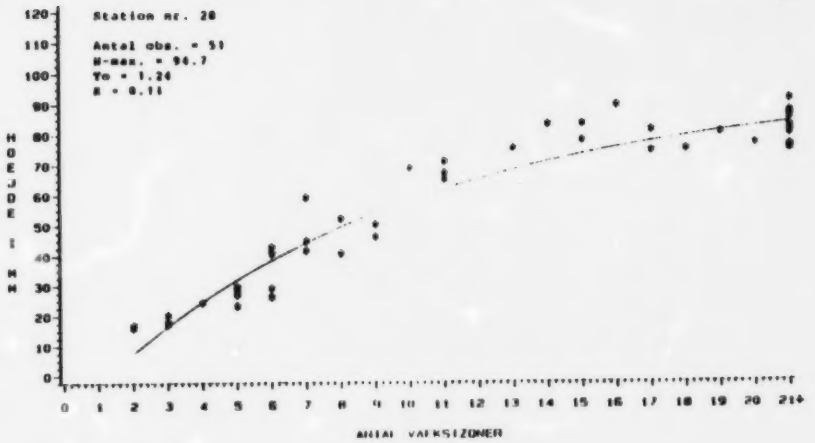

c
ANTAL VAEKSTZONER


d
ANTAL VAEKSTZONER

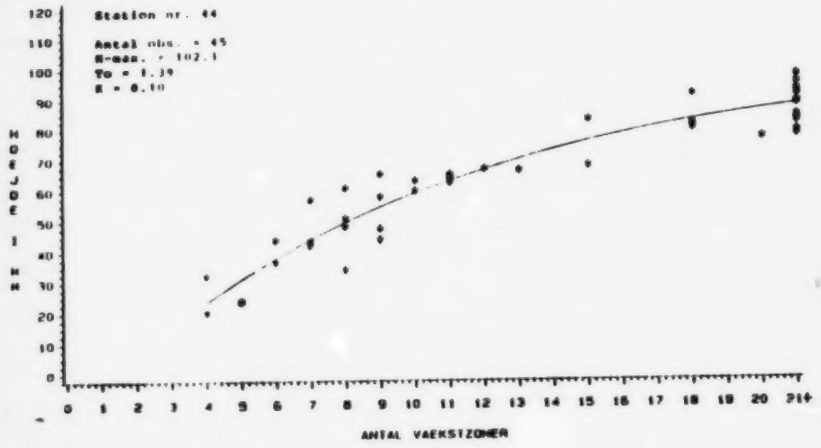
e


Station nr. 20
Antal obs. = 11
ANTAL VAEKSTZONER

f


Station nr. 28
Antal obs. = 51
H-max. = 94.7
To = 1.24
E = 0.11
ANTAL VAEKSTZONER

g


Station nr. 44
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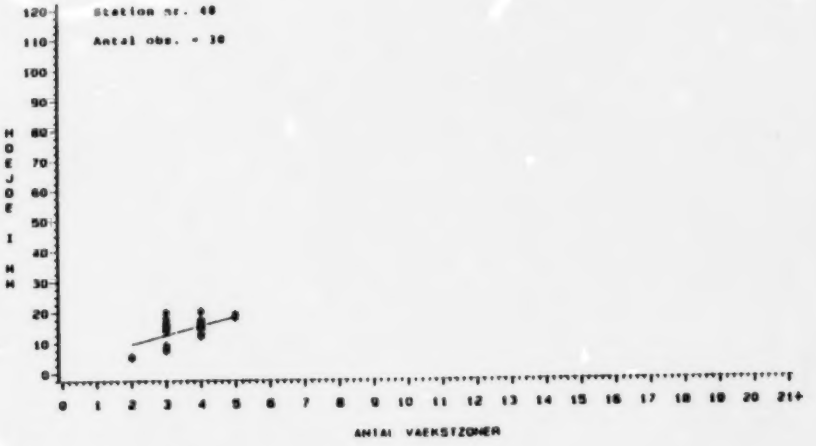
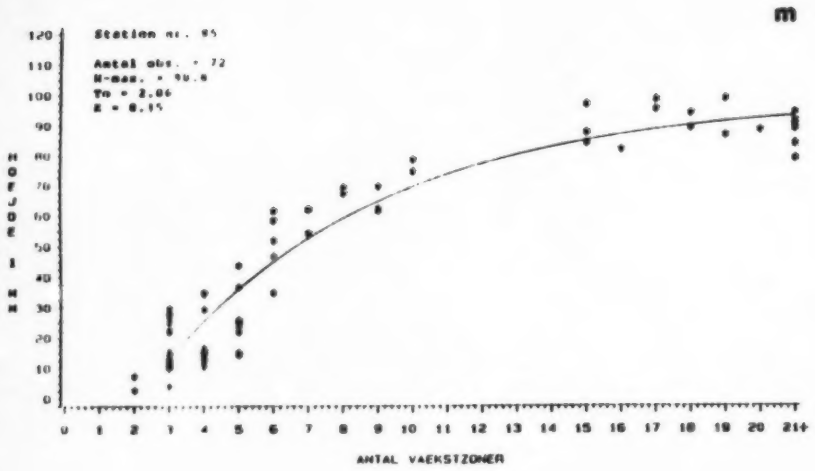
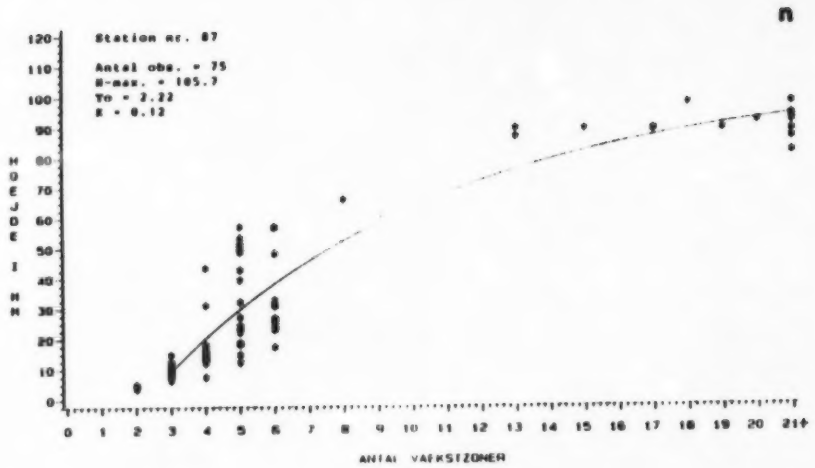
H-max. = 102.1
To = 1.39
E = 0.10
ANTAL VAEKSTZONER

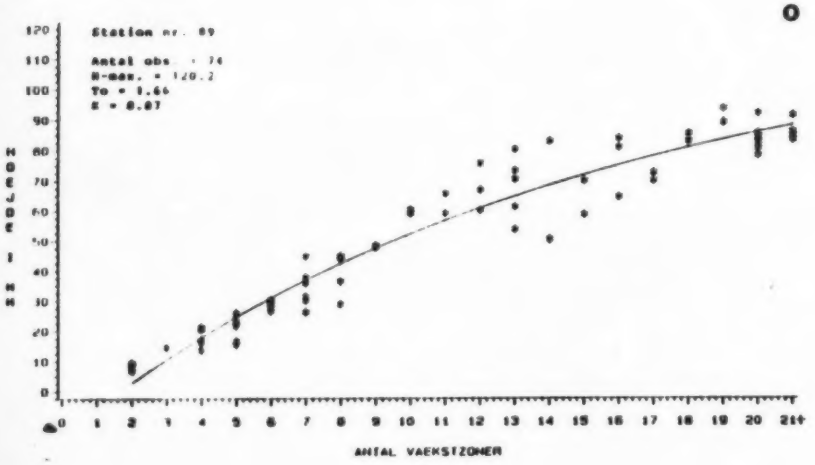
h

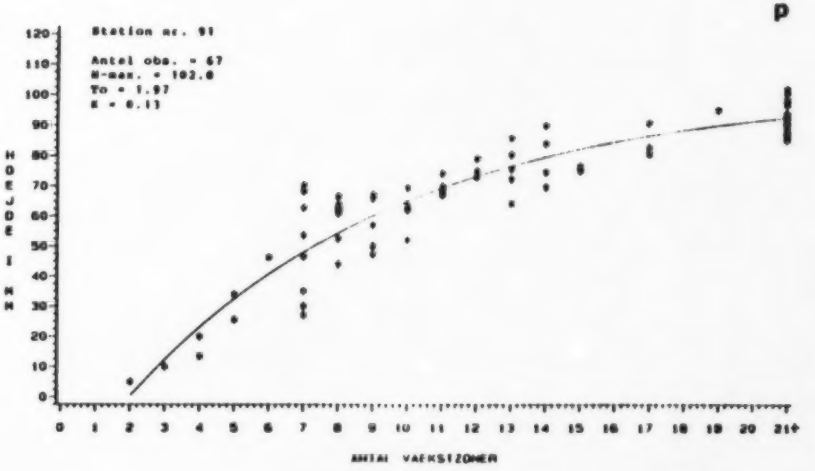

Station nr. 48
Antal obs. = 38
ANTAL VAEKSTZONER

i
Station nr. 68
Antal obs. = 57
R-max. = 89.6
To = 1.01
a = 0.20
ANTAL VAEKSTZONER
HOEJDE I MM
j
Station nr. 61
Antal obs. = 90
R-max. = 106.3
To = 1.30
a = 0.11
ANTAL VAEKSTZONER
HOEJDE I MM
j
Station nr. 52
Antal obs. = 60
R-max. = 115.9
To = -0.40
a = 0.04
ANTAL VAEKSTZONER
HOEJDE I MM
k
Station nr. 64
Antal obs. = 65
R-max. = 65.1
To = 2.20
a = 0.05
ANTAL VAEKSTZONER
HOEJDE I MM

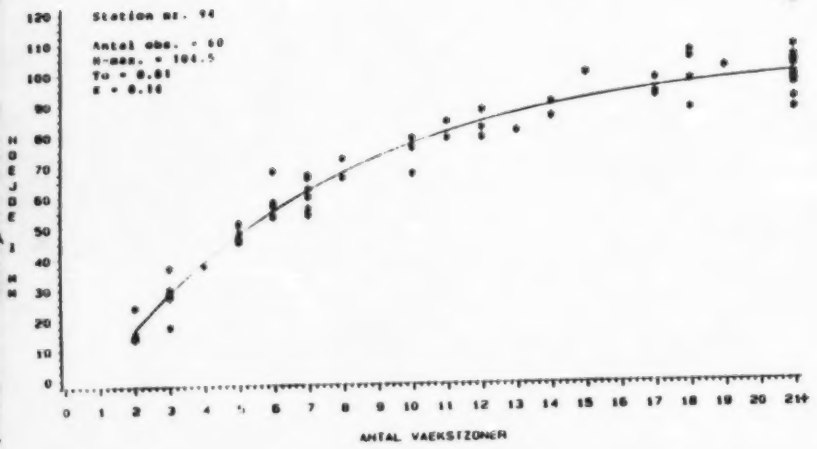


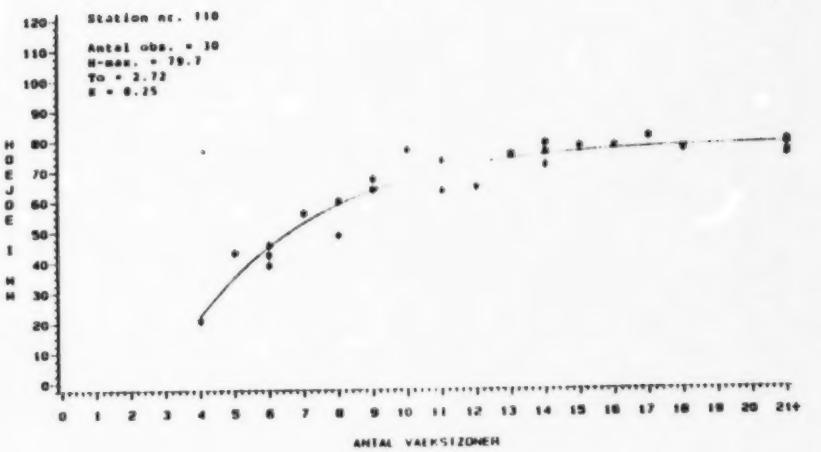


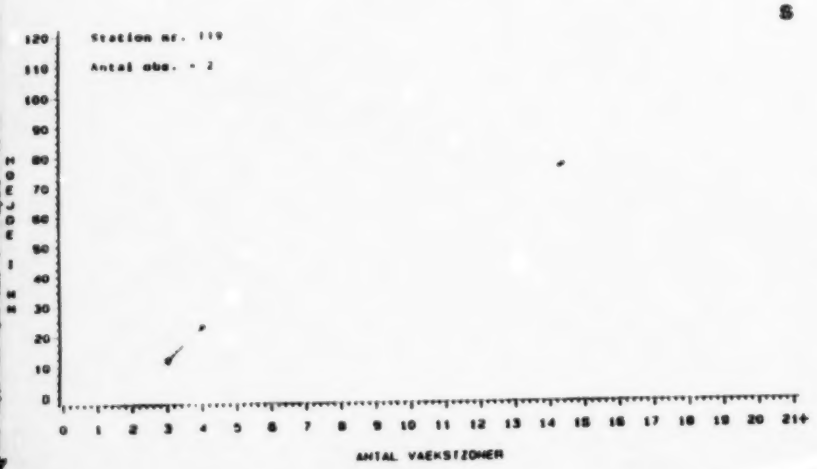


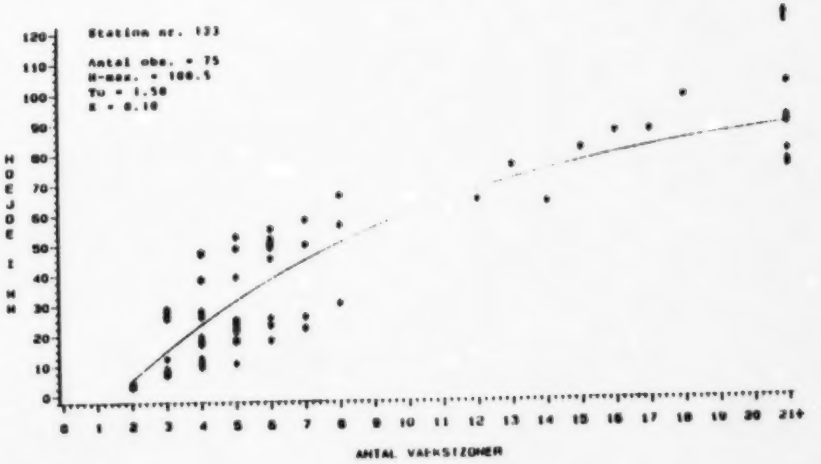


APPENDIX FIGUR 3.8


q
Station nr. 94
Antal obs. = 60
H-max. = 104.5
To = 0.81
E = 0.16
ANTAL VAEKSTZONER


r
Station nr. 110
Antal obs. = 30
H-max. = 79.7
To = 2.72
E = 0.25
ANTAL VAEKSTZONER


s
Station nr. 119
Antal obs. = 2
ANTAL VAEKSTZONER


t
Station nr. 123
Antal obs. = 75
H-max. = 108.5
To = 1.58
E = 0.18
ANTAL VAEKSTZONER

ANTAL VAEKSTZONER